POWER PLANT ENGINEERING

VOL. XXXVI CHICAGO, MAY 15, 1932 No. 10

Contents of this Issue

Page

WITH THE EDITORS....404

SUGGESTIONS FOR PROFITABLE READING....405

POWER FOR THE BRUNSWICK LAUNDRY....406

INCREASING THE EFFICIENCY OF WATER TREATING SYSTEMS. By J. A. Holmes....414

BURNING BITUMINOUS COAL ON UNDERFEED STOKERS. By Bert Houghton....415

ELEVATOR CABLE MAINTENANCE. By C. C. Custer....417

IRREGULAR MOTOR SPEED....419

SERVICE WATER HEATER ESSENTIALS. By W. J. O'Brien....420

ICE PLANT USES HYBRID DIESEL COMPRESSOR UNIT....422

SEPARATORS AT PILGRIM STATE HOSPITAL....424

PRESENT PRACTICE IN INSULATED POWER CABLES. By Donald M. Simmons....425

STANDARD WHEELS IMPROVE CRANE TROLLEY. By Grady H. Emerson....428

DIESEL ENGINE UPKEEP. By Edward J. Kunze....429

PIPE TREATING AND FABRICATION. By J. B. Nealey....431

WHERE TO TAKE DRAFT READINGS. By Lewis L. Emerson....432

LIGHTING THE WASHINGTON MONUMENT....433

READERS' CONFERENCE: PRESSURE DROP ACROSS STEAM PURIFIER. PREVENTIVE SERVICE VS. FIRST AID. PLASTER OF PARIS MODEL FOR DUTCHMAN. SAFEGUARD FOR STEAM HOSE CONNECTIONS....434

PLANT OPERATION PROBLEMS: MOTOR OPERATION PROBLEMS. SAFETY VALVES....436

INVERTED BUCKET TRAP....438

NITRALLOY STEEL PUMPS....438

NOVEL STEAM TRAP....438

GRAVITY SEAL APRON CONVEYOR....438

INSTANT ICE COOLER....438

SMALLER INDUSTRIES CONFERENCE....439

NEWS FROM THE FIELD....439

FOR THE ENGINEER'S LIBRARY....440

Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index, on file in public libraries.

EDITORIAL STAFF

ARTHUR L. RICE, Editor
R. E. TURNER, Managing Editor
A. W. KRAMER, Associate Editor
CHESTER R. EARLE, Associate Editor
RICHARD H. MORRIS, Associate Editor

Published on 1st and 15th of each month, copyright 1932, by the
Technical Publishing Co., 53 West Jackson Blvd., Chicago
New York Office, 171 Madison Avenue

Subscription price: U. S. A. $2 a year; other countries $4 a year. Single copy current issue: U. S. A. 15c, other countries 25c; except January 1st issue U. S. A. 50c, other countries 60c. Single copy back issue: U. S. A. 25c, other countries 35c; except January 1st issue U. S. A. 75c, other countries 85c.

Member, Associated Business Papers, Audit Bureau of Circulations.

Circulation of this issue 23,200

Always Belittling

DAME NATURE?—Sure she's good—all the storybooks say so—but tell me why it took her millions of years to make coal and oil that will be used up in a couple of hundred years; why did she mix it all up with slate, dirt and water; why are most of the waterfalls so inaccessible that they are no good for drinking, looking at or power; why were the coal mines in one part of the country and iron ore in another? Poor management, that's all, poor management—methods that were old when Noah was a boy.

And another thing, take that header above. Laid up with three anchors and not a single expansion joint or bend. Expansion is mighty important in all kinds of lines, especially steam lines. You know making those big pipe bends properly is quite a trick, takes a lot of care, experience and equipment. The little ones? You mean the new rumble seat models with the wrinkles? They are still more difficult to make.

Takes gas, sand, water and a lot of knowing how. Thought you would be interested in these details so we have explained the whole process quite completely in the article on page 431.

The above photograph was taken by Mr. Patterson of Medford, Oregon, and copyrighted by him. It seems that in that bracing western climate it is impossible to kill redwoods. Knock one down and a dozen or so new ones spring up from the old trunk.

Some day when you have nothing to do take a 15 or 20 ft. section of 10 in. extra heavy pipe and make yourself a creased bend. Of course, it takes practice. You can't expect to get the wrinkles all straight the first time. If they are not straight you put the whole thing in a bath of wrinkle remover lotion, made of equal parts of water and acid. The wrinkles disappear as if by magic (along with the rest of the pipe). Then you take a new piece of pipe and start over again. After three or four trys you find out how it isn't done. Then you go out and buy one from a manufacturer and let him worry about the ones with crooked wrinkles.

WITH THE EDITORS

To Better Business

Uppermost in the minds of all are the questions—What path will lead us upward to a better business level and when shall we find the entrance to it?

To lead out of the fog of apprehension and indecision, many plans are proposed but few, if any, are more than expedients. Only by getting labor and capital *profitably* at work can the problem be solved and business restored to a prosperous condition. Labor can be put to work only by the use of capital. It would seem, therefore, that the answer is to get capital at work under conditions which, with wise management, permit a profit to be made. Not excessive profit, such as was anticipated by investors during the late stock-gambling spree, or such as is aimed at by promoters of pyramided holding companies and bear raiders, but a reasonable return to owners of capital for the use of their property, be this apartment buidings, office buildings, factories, machinery or bank credit.

What are the factors which are preventing profitable use of capital? Fundamentally two things—high cost of production and lack of purchasing power to form a market.

Elements in high cost of production are high overhead,—due to excessive capital tied up in plant, to unreasonable taxes resulting from waste and extravagance of political manipulation of government, to high cost of distribution and selling and, in some lines, to high cost of labor.

Clear understanding of the requirements for improvement in business and industry is a first essential: Reduced cost of overhead including excessive investment and tax charges, inefficient management, extravagant cost of supervision; reduced cost of production by better planning and design, better plant and machinery, cooperation of workers and, where conditions justify, lower hourly wage; reduced cost of sales and distribution, in some cases by cooperative action, in some by limitation of territory, in some by reduction and simplification of product, in some by better economy in shipping and delivering.

If capital can be gotten to work profitably, increased wages, hence purchasing power, will necessarily follow since workers must be employed. To get the largest market for products, distribution of as large wage payments as consistent with a cost of production that will permit an attractive selling price is desirable. But it may happen that reduction of hourly wage rate will reduce cost of production so that sales can be increased, more employment given and larger weekly wages paid than if hourly rate is so high that sales possibilities are restricted. The worker's return is greater, because his weekly wage is increased, and because prices of goods are lower so that he can get more for his money.

In each case, what should be done will vary but the fundamental requirements must be met. Reduction of the tax burden is a universal need and will be attained only by concerted effort that will convince government spenders of the need and determination of the people to have relief.

To meet other requirements will call for harmonious effort of financiers, executives and workers. The effort must be made. We cannot float back to prosperity. Those who will not help, whether from personal seifishness or from inability to comprehend the needs of the situation should be ridden over rough shod. The necessity of the country for recovery of business and industry brooks no hindrance or opposition to those measures which must be taken to achieve success.

Experience Through Failure

Failures of structures are expensive both from the standpoint of property damage and loss of human life. Except in the case of specific tests to destruction, failures are not to be condoned. When such failures do occur, however, full investigation should be made of the causes of failure so as to avoid their repetition.

This is particularly true of modern designs for, since fuller knowledge of materials and construction is available, factors of safety have been reduced in some parts so as to make the strength of the entire structure more uniform.

In the case of dam failures a few disastrous examples stand out, although it is hard to realize that over the last century and a third such failures have been occurring at the rate of more than two a year. During a symposium before the A.S.C.E., M. C. Henderlider lists some 293 dams which have failed since 1799.

In the earth-fill group inadequate spillways were directly responsible for 28 per cent of the failures with an additional 5 per cent due to the same reason but with unusual flood conditions caused by failures further up stream. Inadequate cut-off and porous foundations were responsible for 11 per cent of the failures with another 11 per cent due to inadequate cut-off around conduits. Further causes were excessive fines, 8 per cent and faulty construction 9 per cent, the latter including improperly packed earth and too steep slopes.

Inadequate spillway capacity was also the predominating cause of failure in rock-fill structures as well. It was also an important factor (9 per cent) in the masonry gravity group but was not as important as inadequate cut-off walls in porous foundations which was responsible for 31 per cent of the failures in this group. Improper sections and poor masonry were each blamed for 12 per cent of the masonry failures. Ice pressure or damage accounted for another 9 per cent of the total.

Such investigations, properly analyzed, point the way to the most important sources of failure and warn the designer of features which warrant close study. The large percentage of failures due to inadequate spillway and cutoff walls indicates improper preliminary investigations of runoff and soil conditions. Recently in discussing design for a territory where runoff records over a period of three generations show no excessive floods, a prominent engineer pointed out the importance of the spillway "for the flood that never comes." It is the unseen factor that the engineer must anticipate through experience.

Suggestions for Profitable Reading

Now Let's Take This Dirt Situation

No, you take it! We don't want to have anything to do with it. Of course, you might be tempted to say that it's our business to "dish out the dirt" about the power business. But that's a different kind of dirt. The dirt we refer to has a most important effect on the relation between electric trucks and hot water. That in turn has a most intimate relation to a tremendous industry, which couldn't exist without a great deal of dirt. As a matter of fact, in the plants making up this industry, every bit of power used, whether generated or purchased, is employed for the primary purpose of moving dirt from one place to another.

What? You don't see what we're driving at? Why it's perfectly clear. The power plant industry, as you know from sad experience, doesn't think much of dirt. You take every possible precaution to keep dirt out of your fuel, to get boiler feedwater that is physically and chemically clean, to keep every piece of equipment inside and out free from "foreign matter," as the highbrows say. Then when you get all through using these things to make power and steam, you have some flue gas to get rid of and you take all precautions to discharge that gas to the circumambient atmosphere in as clean a state as possible—"for the smoke inspector'll git ya, if ya don't watch out!" And in doing all these things you have to use up some of your power.

Well, in these laundries we speak of, the entire output of their power plants is used for moving dirt—transferring it from clothes where we don't want it to the sewer where it won't annoy us any more.

Laundries? Why, of course, that's what we've been talking about all the time. They all require tremendous quantities of hot water and the Brunswick Laundry, the power plant of which is described in this issue, being the largest laundry in the world is a good typical example. Now the reason why the electric trucks - - - -

Aw, heck! We find that we haven't any more space to tell you about the electric trucks and the hot water but anyway all the information about that is in an article that begins on the next page. You will also learn why the boiler room of this plant was built above the engine room. Also about the 80,000 gal. water tank in the tower, and why they run an engine all night to heat the water for the morning bath.

Now That the Dirt's All Washed Up

But is it? Now that everybody gets into hot water, whether it's Saturday night or not and humans as well as their clothes must be laundered, not to mention all sorts of materials used in industrial processes, a copious supply of hot water is an industrial and domestic necessity. To produce this, you must have the right kind of water heaters, properly connected and equipped. In this issue, Mr. O'Brien takes exception to some of the ideas on heaters advanced in a recent issue and tells how he believes the job should be done. He tells you why, too, so that you can analyze your own installation.

They All Fall If You Have Enough S. A.

That's an abbreviation, not for sex appeal, but for sodium aluminate. Of course that way of writing it won't satisfy the high-powered chemical engineers, who call it $Na_2\ Al_2\ O_4$. In feedwater treatment, you often want to form a floc in which all particles of scale forming matter will be caught and held, so that perfectly clear water can be drawn off above. Well, as we said before, the big particles and the little particles will fall for you if you have enough S.A. and in this issue Mr. Holmes tells you just how to get enough.

The Monkey Gland Surgeons Are Still At It

Last month we told you how these enterprising fellows are doing surprising things these days in the invigoration of electrical and mechanical equipment to make it assume new and better forms. Well, you may be interested to learn that now they've turned their attention to the ice plant, with startling results.

Talk about two-headed cows and four-legged hens that grow combs like roosters! Why, their latest stunt is to produce a machine that's three-fifths Diesel engine and two-fifths ammonia compressor. And does it work! Well, one of these hybrids is installed at the Long Beach plant of the Knickerbocker Ice Co. and, according to the plant records, gives them a ton of ice for 3.3 gal. of fuel oil.

Now, by the beard of Dr. Steinach, if you need any more good evidence that the monkey glands are working properly, turn to page 422 and study the picture of them in action, taken especially for you by Power Plant Engineering's enterprising staff photographer.

Giving Humanity a Lift

In the tight little island that is reputed to exist solely on a diet of rare roast beef and ale, (although Will Rogers says that now they are eating from hand to mouth—when they eat—and some times they eat the hand, too) the quaint custom persists of referring to an elevator as a lift. Americans often find difficulty in adjusting themselves to this habit of calling things by the wrong names. That is especially true when they think of a subject as important as elevators, without which our American cities and industries could not exist. Whatever you call them, however, they are among the most useful and exciting gadgets the human race possesses. Giving humanity a lift, in the physical sense, is one of its most important activities.

The slender steel threads on which hang the lives and business activities of our great skyscrapers must not fail. How frail they look, yet how well they do their job! To insure that continuous, reliable performance is as important as maintaining beacon lights for mariners.

Knowledge of requirements for proper selection, installation and care of elevator cables is vital to the plant executive in responsible charge. In this issue Mr. Custer, speaking from long experience with them, discusses these points in a most illuminating fashion.

POWER PLANT ENGINEERING May 15 1932

Power For The Brunswick L

New Power Plant for the Brunswick Laundry at Jersey City, N. J. has boiler equipment rated at approximately 2000 hp. It supplies all steam, hot water and electric energy for the largest laundry in the world.

SOME TWENTY-FIVE years ago, the laundry industry occupied a comparatively insignificant position among the various industries of the country. It was composed of small individual laundries started on a small scale in stores and frame buildings without any specific method or system—without even a thought for future expansion and, of course, with very meager engineering and scientific attention. Having discovered a wide field of endeavor, however, they forged ahead and in a short time built up a billion dollar industry, classified today as the fifth largest in the country. With this progress, the stores and small frame buildings were replaced by modern, sanitary plants, with mechanical equipment, operated by scientific methods, under the direction of skilled chemists and competent engineers.

An outstanding example of this growth and progress is the great plant of the Brunswick Laundry at Jersey City, N. J. Like other laundries, this plant began years ago with one small building but today has grown so that it occupies 5 large buildings, modern in every respect and covering a ground area of 320 by 210 ft. It is claimed to be the largest laundry in the world.

Since its beginning, this laundry has maintained its own power plant, furnishing all steam, hot water and electricity to the laundry. As the laundry grew, this power plant was also enlarged from time to time, usually by the simple expedient of adding a boiler or engine whenever the necessity arose. The result of this gradual expansion can be imagined; the layout was not one of design and planning but of expediency. For some time, therefore, the management had realized that a more logical arrangement was desirable.

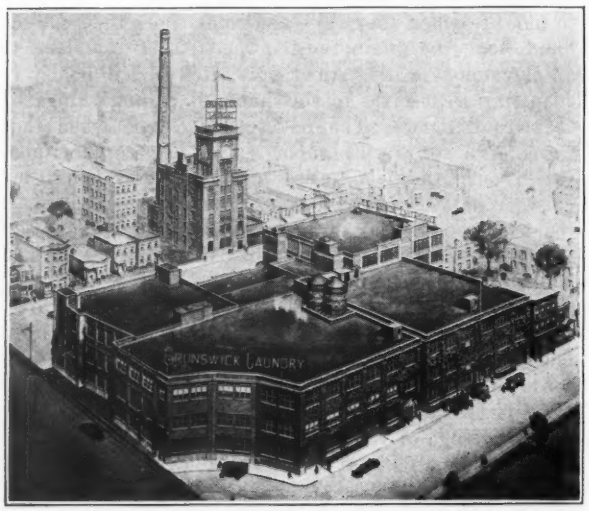


FIG. 1. VIEW OF BRUNSWICK LAUNDRY SHOWING RELATION OF POWER PLANT TO LAUNDRY PLANT

Having had their property cut off at one end recently by the state highway approaches to the Holland Tunnel, which made the addition of more boilers impossible, and which forced them to change the location of the entire power plant, the owners of the Brunswick Laundry, Henry, William and Stanley Sieminski, realized that it was the proper time to solve their power problem once and forever in accordance with modern engineering principles. So a new plant was decided upon.

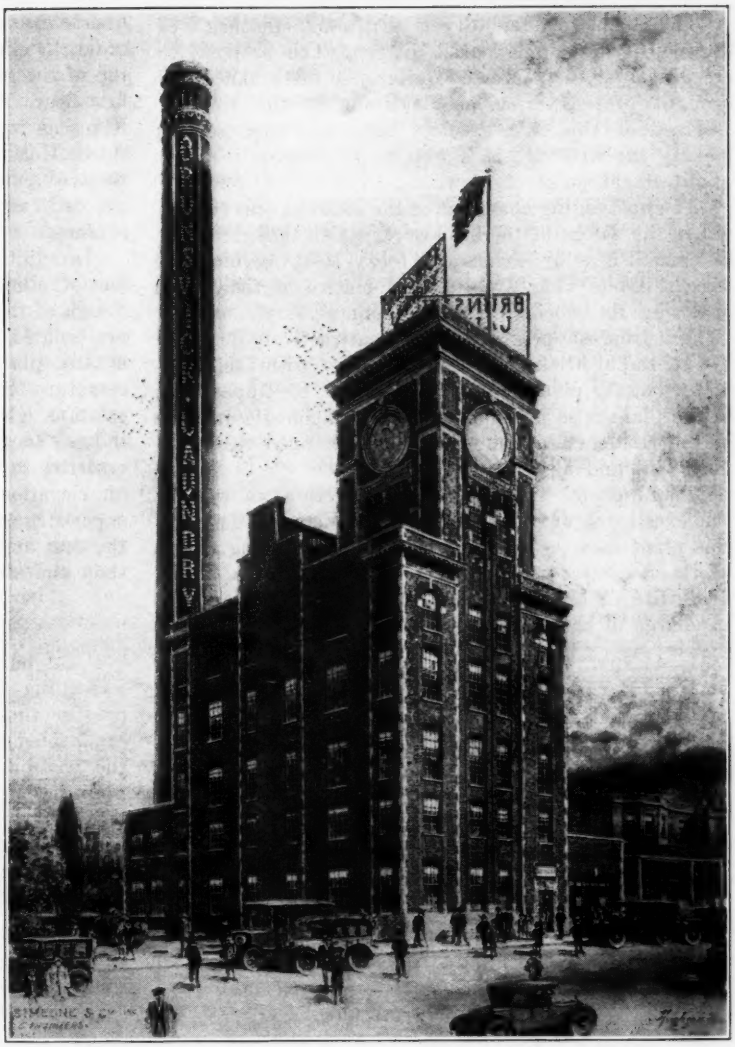
In deciding upon this move, special attention was devoted to the selection of a suitable location which would not hamper the growth of the laundry proper and which would include provision for the future extension of the power plant itself. The actual construction also involved important considerations. In the first place, a definite determination had to be made as to which parts of the old power plant were still in good serviceable condition and which could be used advantageously in the new plant. Secondly, it was essential that production in the laundry be maintained during construction. This made necessary the transfer of equipment from the old to the new plant without shutting down an instant.

All this involved a high degree of engineering foresight. Not only was the power plant involved but much of the piping in the laundry plant itself was affected. The new plant is located across the street from the laundry, the old was among the laundry buildings. This involved changing steam water and condensation piping throughout the plant at every step.

After a careful analysis of the equipment in the old plant, it was decided that only the two latest 300-hp. B. & W. boilers and two Corliss engine generator units could be utilized. The remainder of the equipment consisting of numerous and varied types of water heaters, pumps, storage tanks, traps, etc., was found to be obsolete; therefore, not to mar the design of the new plant, this equipment was scrapped.

The new plant is quite unique in its design. Because

k Laundry



of the limited ground area available for the construction of the new plant, it was necessary to dispose the various divisions vertically rather than horizontally. The engine room is on the ground floor. Above this, on the second floor, are the fan and pump rooms and the air compressors, while the boiler room occupies the third floor.

Boiler equipment consists of four Babcock & Wilcox water tube units, stoker fired and equipped for forced draft operation. Two of these are new units rated at 509 hp. each. The other two are the old units formerly installed in the old plant. These were originally rated at 300 hp. but with their transference to the new plant, additional heating surface was added to bring the capacity up to 450 hp.

Main generating equipment consists of three Corliss engines driving direct current generators, two of which were moved from the old plant and the third is a new 700-kw. Allis-Chalmers unit.

In building the new plant, first the two new boilers and the new Allis-Chalmers engine were installed and placed in operation. When this was done the old engines and boilers were moved over.

It might be wondered why Corliss engines and direct current are used. This was due to several factors. In the first place, the old units were in good condition and it was desired to have a plant of uniform design. Secondly, the laundry had been developed to use direct current—all the motors on the washers were d.c. units of the reversing type, having excellent speed and control characteristics and it was imperative to retain them. The Corliss engine, furthermore, is an excellent slow speed drive for d.c. generators.

There was still another factor, however, and this was the question of operating the electric trucks and that of water supply. The company operates a large fleet of electric trucks for delivery purposes. These are charged every night from the 115-v. mains. Thus, the engine generators operate all night, not only furnishing current for charging the trucks, but also exhaust steam to heat water in an 80,000-gal. storage tank in the tower of the power plant building.

The primary requirement of any laundry is, of course, hot water in large quantities together with process steam at 100 lb. pressure. In the design of this plant, therefore, the utmost attention was given the question of economical generation of both steam and hot water, with electricity as a by-product. The amount of hot water used in this plant is enormous. The washers use 13 changes of water for each change of clothes. During the day the operation of the washers is more or less staggered but in the morning when the plant starts up all the washers are turned on at once. The starting of all the washers in the morning at once, naturally imposes a terrific drain on the source of hot water supply, indeed, the demand often is from 60,000 to 80,000 gal. an hour. To supply this need, the 80,000-gal. tank was provided. This tank is built of cypress and holds 80,000 gal. of water, usually at between 160 and 175 deg.

With this more or less general consideration of the plant's requirements, we are now better able to proceed with a detailed description of the plant.

Plant Located in Heart of City

The Brunswick Laundry is situated in the heart of Jersey City in a residential district. The proposal to erect a power plant created quite some disturbance and brought protests from people living in the vicinity. Because of this, the greatest care was exercised in making the structure as attractive as possible from an architectural point of view.

The upstanding character of the building was carried out in the design of the brickwork, which though simple is embellished by means of terra cotta cornices at various levels. The architectural motive of the tower, enclosing the wooden tank, is more elaborate as may be seen from the photographs. An attractively designed 176-ft. radial brick chimney harmonizes with the architecture of the plant as a whole. Indeed, the appearance of the plant is so pleasing that the antagonistic attitude of the residents in the vicinity has changed to one of good will and admiration.

The unusual success in this direction as well as the excellence of the engineering which characterizes this plant must be attributed to the painstaking efforts of the designers and engineers, P. O. Simeone & Co., Inc., with C. K. Solski, Mech. Engineer of Jersey City in charge of the work.

The entire second floor, known as the fan room floor, has been waterproofed by the membrane method, in order to eliminate the possibility of water leakage on top of the generating units and other equipment on the first floor. The third floor, that is, the boiler room floor, has been waterproofed by the integral method, using A. C. Horn waterproofing materials. The floor slab in the tower under the water tank is also membrane waterproofed with ample drainage provision for obvious reasons.

In addition to these features, there are quite a number of other interesting features about the structural design of the plant. All engine foundations for instance are isolated and not in contact with the building proper at any place. The stack is carried on a steel superstructure 27 ft. above grade, and the supporting columns, girders, braces and foundations here also are independent of the building proper. This framing was resorted to because of the position of the boilers at an elevation of 127 ft. By this arrangement of the super-structure, the valuable space below the stack on the first and second floors was utilized for the machine shop and storage room respectively.

Coal and Ash Handling

Coal handling equipment at this plant consists of a loading hopper, reciprocating feeder, double roll crusher and elevator conveyor. The crusher and feeder are located below the driveway level, totally eliminating the possibility of spreading coal dust throughout the plant. Delivered to the plant in 5 or 6-ton trucks, the coal is weighed on a 20-ton scale and discharged into the receiving hopper. From the crusher, the coal is conveyed vertically and then horizontally finally discharging into a steel suspension bunker through steel chutes

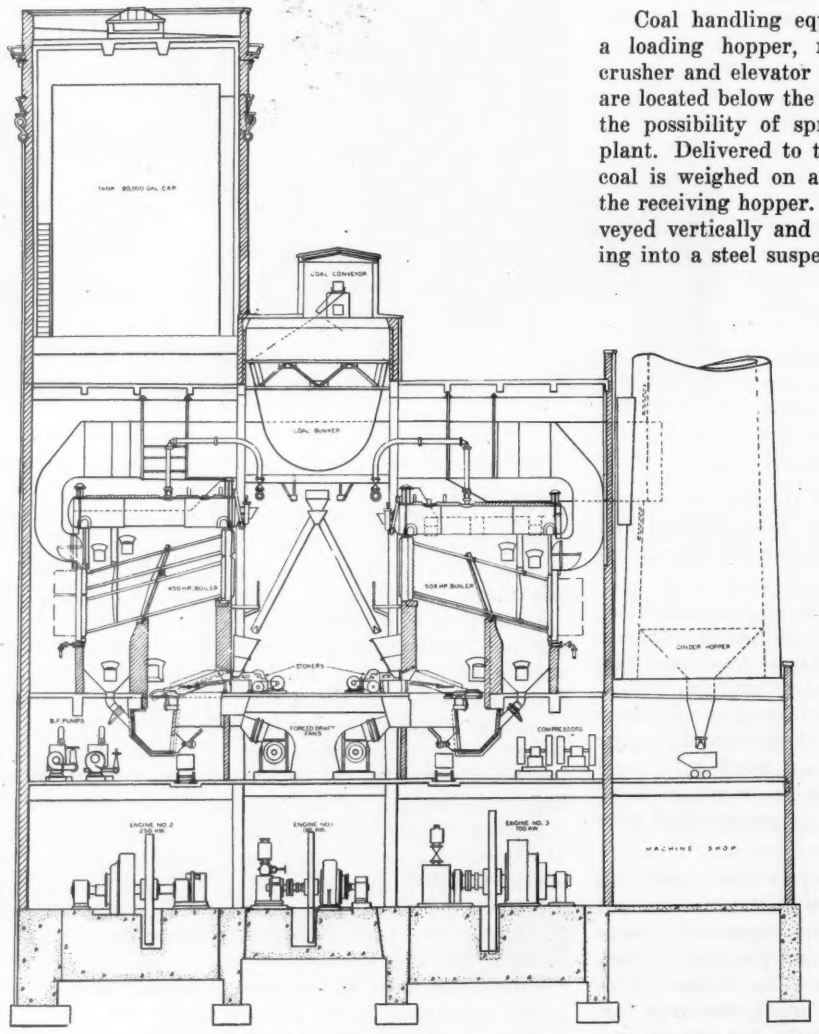


FIG. 2. ELEVATION, SHOWING ARRANGEMENT OF EQUIPMENT IN PLANT. THE FORCED DRAFT FANS ON THE SECOND FLOOR REMOVE WARM AIR FROM THE ENGINE ROOM AND DELIVER IT TO THE FURNACES ABOVE

provided with rack and pinion operated gates, which permit regulation of flow to either end of the bunker. From the bunker the coal is drawn through cast iron bunker gates into a travelling larry, which weighs the coal again before delivering it to the stokers.

The double roll crusher was selected because fundamentally it consists of two wheels revolving towards each other at the same rate of speed, crushing the coal without tearing or regrinding. A safety shearing pin is provided which releases the motor in case any hard foreign substance jams the rolls.

In the design of the coal elevator, several unusual features were introduced. The elevator which is of the V bucket type has its vertical run totally enclosed in a brick wall forming an integral part of the building. With this construction the designers broke away from the conventional steel duct, thereby eliminating the possibility of metallic casing sounds and noise. At various levels, ample size, air tight inspection doors are provided.

Special care was exercised by the designers to provide easy access to all parts of the system, thereby facilitating maintenance. With this aim in view steel grating runways, stairs and ladders were provided and in order to avoid possible injuries to workers, mechanical and electrical safety devices were liberally embodied in the design throughout the entire plant. Full electrical safety control features were provided for the crusher and conveyor motors. The coal bunker is of the suspended type constructed of steel plate and has a capacity of 150 tons. To prevent corrosion, the interior has been lined with a coat of Bitumastic solution applied cold, followed by one coat of Bitumastic enamel applied hot and then by one layer of vitreous tiles laid in cement mortar. The coal larry is of the floor operated type, hand propelled and of 1000-lb. capacity.

Ash drops from the stoker dump grates directly into the ash hoppers attached below the boilers to the boiler supporting building steel. From these hoppers, it passes through pivoted hand operated ash grates into narrow gage rotating dump type ash carts of 18 cu. ft. capacity. These carts are wheeled to the main storage ash hopper on narrow gage tracks permanently laid into floor slab. The main storage ash hopper is of approximately 250-cu. ft. capacity, made of plate steel and lined with Bitumastic solution, Bitumastic enamel and Vitreous tile laid in mortar.

The ash hoppers under the boilers are made of ⅜-in. copper steel plate, stiffened with angles with all seams welded inside and out, making construction rigid, air and water tight. In order to resist temperature changes and erosion, the hoppers are lined with vitrified shale brick laid on edge in Portland cement mortar. Each hopper is fitted with two water quenchers.

Soot from the stack is removed by the ash carts to the main ash hopper. It will be noted that the main ash hopper is located directly above the coal receiving hopper in the driveway so that the trucks after delivering coal can readily take away the ash without changing position.

Boilers and Furnaces

As shown in the cross section, the boilers are installed on the third floor above the forced draft equipment. As stated previously, there are four boilers, two of which are new and two were moved over from the old plant. All are Babcock and Wilcox, two-drum boilers, the new ones with an effective heating surface of 5087 sq. ft. and rated at 509 hp., the old ones with a heating surface of 4540 sq. ft. and a rating of 454 hp. All boilers are constructed for a working pressure of 160 lb. but are operated at 115 lb. gage. The two 509 hp. boilers are fired by two 6 retort standard underfeed Riley stokers while the smaller units are fired by 5-retort stokers.

All boilers are set with a furnace height of 12 ft. Side bridge and front walls of the settings are protected with Bernitz Super blocks and Carborfrax carborundum bricks to a mean height of 20, 27½ and 24

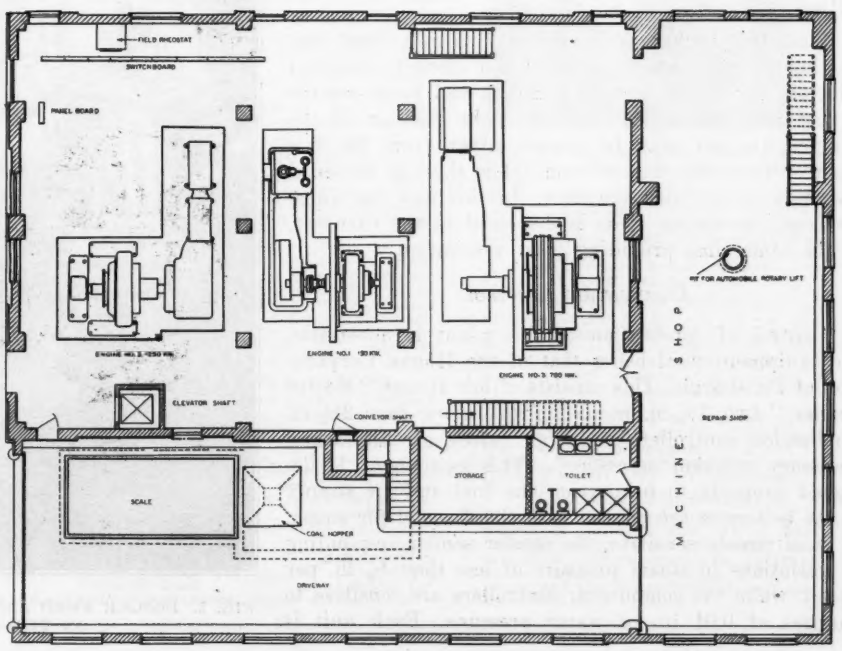


FIG. 3. PLAN OF THE GROUND FLOOR, SHOWING ARRANGEMENT OF ENGINES. THE 175-FT. RADIAL BRICK STACK IS MOUNTED ON A SUPERSTRUCTURE, THUS PROVIDING SPACE FOR THE MACHINE SHOP BELOW AS SHOWN AT THE RIGHT

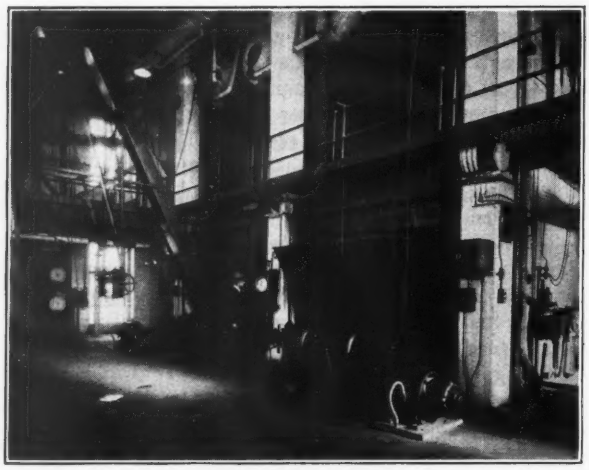


FIG. 4. IN THE BOILER ROOM, SHOWING THE TWO NEW 509-HP. BOILERS

in. respectively. On top of the front walls, directly above the header protecting tiles, special drain troughs are placed. These are constructed of 12-in. channels, laid with a slight slope toward the side wall ends. Seal plates at the ends have 2-in. drain nipples connected to a 2-in. brass pipe extended to the boiler room floor.

With the settings provided, the forced draft and stoker equipment, these boilers are easily capable of operating continuously at 200 per cent rating.

Draft Equipment

Forced draft is supplied by four "Sirocco" fans, one for each boiler unit, installed in a fan room, directly underneath the boilers. The fans for the 509-hp. units each have a capacity of 16,000 c. f. m. against a static head of 5½ in. while those for the 450-hp. units are rated at 14,000 c. f. m. These capacities were determined upon a basis of 250 per cent rating for the boilers.

Each fan discharges the air into its own wind box. The inlet of each fan is connected to a specially designed inlet air box provided with dampers and brass screens on top and bottom. According to the position of the damper, the air may be drawn either from the fan room or from the engine room below through screened openings in the fan room floor. In this way the warm air from the engine room is delivered to the furnaces, at the same time providing good ventilation.

Combustion Control

Control of combustion at this plant is automatic, the equipment used being that of the Hagan Corporation of Pittsburgh. This consists of one Hagan "Master Sender," two 2½-in. receiving regulators, four 2½-in. combustion controllers, reducing valves, air filters and necessary erection accessories. This equipment is designed properly to proportion the fuel and air supply to the boilers in accordance with the demand for steam. It is extremely sensitive, the master sender responding to variations in steam pressure of less than ¼ lb. per sq. in. while the combustion controllers are sensitive to changes of 0.01 in. of water pressure. Each unit is completely self compensated and as the compensating element is adjustable on each machine, any desired condition may be set up and maintained. The machine will respond immediately to changes in load or draft and, if necessary, will operate the controls from wide open to tight shut, or the reverse, in a period of less than three seconds. This quick operation is not only essential for the sake of economical operation but it is also advantageous from the standpoint of smoke prevention, as the plant is located in the center of the city and smoke emission is absolutely forbidden.

This system of combustion control was arranged to provide a system of compensated draft, having for its purpose the maintenance of equal rates of combustion in all boilers, regardless of variations in the fuel bed resistance of several other units, and the regulation of fuel and air in accordance with load in correct proportions at all ratings. The apparatus is providing continuous operation without any special maintenance or attention, with provisions for immediate disconnection and operation of the system manually.

Hot Water and Feedwater Heating is Fully Automatic

As brought out previously, the production of hot water in this power plant is of primary and predominating importance because of its vital usefulness in the operation of the laundry. The system had to meet three important requirements:

1. Maintain a steady temperature of 180 deg. F.

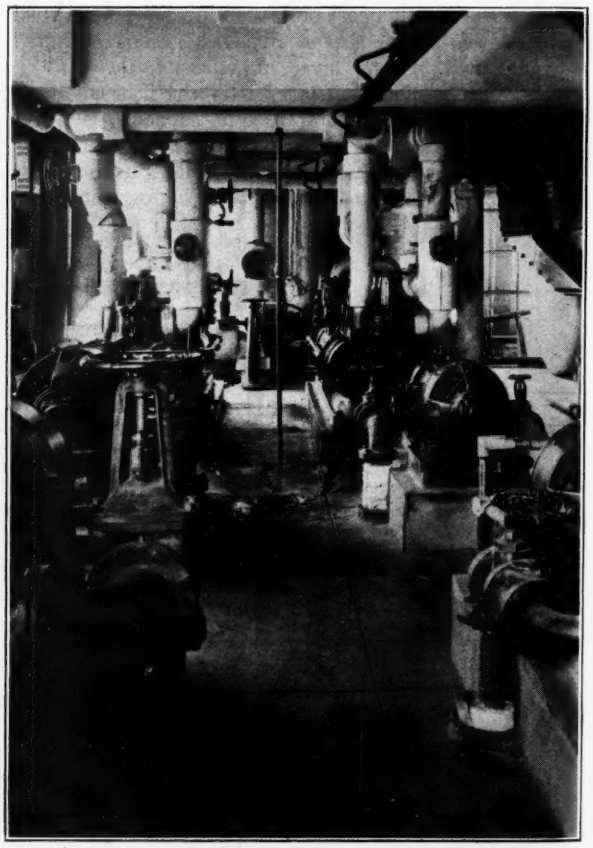


FIG. 5. BOILER FEED AND OTHER PUMPS ARE LOCATED ON THE SECOND FLOOR

Equipment in the Brunswick Laundry Co. Power Plant

GENERAL

Location: 68-72 Liberty Ave., Jersey City, N. J.

Size of plant: at Engine Room Level 75 ft. by 100 ft.; Engine Room 50 ft. by 75 ft.; Boiler Room 50 ft. by 75 ft.; to Main Roof 66 ft.; to Tower Roof 108 ft. 8 in.

Building Contractor: D'Elia Contracting Co.

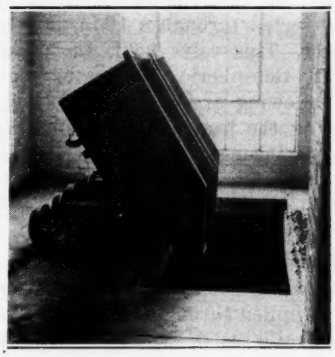
Piping Contractor: M. J. Gill Eng. & Equip. Co.

Electrical Contractor: John C. Morris, Inc.

Elevator Contractor: Otis Elevator Co.

Associated Structural Engineers: Di Stasio & Co., N. Y. C.

Architects and Engineers: P. O. Simeone & Co., Inc., Jersey City, N. J.



BOILERS, FURNACES AND STOKERS

2 Babcock & Wilcox wrought iron steel sectional water tube boilers each with a nominal rated heating surface of 5087 sq. ft. and a rated capacity of 509 hp.

2 Babcock & Wilcox wrought iron steel sectional water tube boilers, transferred from old plant, re-installed and rebuilt to a rated capacity of 450 hp.

4 Furnaces, two double settings 509-hp. Boilers Settings: Furnace depth of stoker 8 ft. 9½ in.; Furnace width of stoker 9 ft. 6¾ in.; Furnace width of boiler 10 ft. 10 in.; Furnace height 12 ft. 0 in.; Width of air chamber 9 ft. 9¾ in. 450 hp. Boilers Settings: Furnace depth of stoker 8 ft. 9½ in.

First quality bricks used, type "Wynn" fire bricks manufactured by the General Refractories Co. Bricks to withstand temperatures of 3000 deg. without deformation under a load of 100 lb. per sq. in., and with a crushing strength of 1500 lb. per sq. in.

Each furnace in the area of the fuel bed is lined with non-clinkering air-cooled furnace blocks, manufactured by The Bernitz Co.

4 Riley Stoker Corp.

2 6 Retort Standard Underfeed Stokers with setting to operate boilers normally at 250 per cent or rating. Horizontal projected area 84.07 sq. ft.

2 5 Retort Standard Underfeed Stokers, same as above and with 79.06 sq. ft. of horizontal projected area. Stokers driven by Allis-Chalmers 5 hp., 125 d.c., 400 to 1200 r.p.m., adjustable speed semi-enclosed motors, with silent chain drives and guards. Each motor with magnetic starter, overload protection and field relays, field rheostats and push button stations.

20 Units Diamond Power Specialty Corp.

5 Units on one side of each boiler.

4 Northern Equipment Co., Copes Boiler Feedwater level regulators, one for each boiler.

FANS AND DRAFT EQUIPMENT

4 American Blower Co., forced draft fans with non-overloading characteristic of which:

2 Fans supply 16,000 c.f.m. of air at 70 deg. F. against a static pressure of 5½ in. measured at the stoker air inlet when operating at 250 per cent.

2 Fans supply 14,000 c.f.m. of air at 70 deg. F. against a static pressure of 5½ in.

16,000 c.f.m fans driven by 25 hp., 1800 r.p.m., 115 c., d.c. Allis-Chalmers shunt-wound motors.

14,000 c.f.m. fans driven by 20 hp., 1675 r.p.m., 115 v., d.c. Allis-Chalmers shunt-wound motors.

1 M. W. Kellogg Co. stack constructed of radial face bricks with terra cotta trimmings and radial fire brick lining. This chimney supported on a superstructure 27 ft. above grade: 176 ft. high, 22 ft. dia. at the base and 9 ft. 6 in. at the top.

1 Connery Co., breeching of ⅛ in. plate (steel) with master joints and cast iron asbestos packed cleanout doors.

4 Inlet boxes for fans of ⅛ in. steel provided with a damper and screens.

4 Wind boxes of ⅛ in. steel provided with deflector plates.

1 Stack spout of ⅛ in. steel and provided with cutoff gate.

COAL AND ASH HANDLING

Coal conveying equipment furnished by the R. H. Beaumont Co. Capacity 40 tons per hr. Crusher and bucket elevator driven by 15 hp., 115 d.c. 1150 r.p.m. Allis-Chalmers motors totally enclosed and pipe ventilated type.

1 R. H. Beaumont Co. suspension type coal bunker, capacity 150 tons, ¼ in. thick copper bearing steel lined with Bitumastic Enamel and Tile lining.

1 R. H. Beaumont weight larry 1000 lb. capacity, floor operated with two spouts; each chute with rack and pinion gates at the top.

4 R. H. Beaumont copper steel ash hoppers with water quenchers, soot chutes hand operated, pivoted ash gates lined with vitrified shale bricks.

2. 18 cu. ft. ash cars.

1 Connery Co., Main ash hopper of ⅜ in. steel tapered at the bottom and provided with rack and pinion, water tight drain gate, lined with Bitumastic Enamel and Vitreous Tile.

COMBUSTION CONTROL SYSTEM

Hagan combustion control consisting of:

1 Hagan master sender

2 2½ in. Receiving regulators

4 2½ in. Combustion controllers, Air filters, Reducing Valve and accessories.

4 one for each boiler, Hays V-3 pointer type draft gages, with electric lamp attachments, measuring wind box over fire and last pass drafts.

2 one for each boiler, Hays model C, CO_2 recorder with Hays flue gas temperature elements, and electric clocks.

2 Cochrane indicating, recording and integrating steam flow meters with monel metal orifice plates and electric clocks, one recording total laundry load and one the steam to the hot water heater.

2 Cochrane indicating, recording and integrating water meters with temperature recording elements and electric clocks, one recording hot water to laundry, and the other the amount of hot water returned to hot water tank.

FEED PUMPS AND FW HEATER

2 Dean Brothers horizontal durable duplex, double acting plunger boiler feed pumps 12 in. by 7 in by 12 in. each. Each pump displaces 160 g.p.m. when operating at 40 strokes per min.

1 Cochrane Corp. 2000-hp. Armco Iron Deaerating heater with vent condenser and capacity of 85,000 lb. per hr.,

STEAM ENGINES AND GENERATORS

1 Hooven, Owens, Rentschler Co., 24 by 36 heavy duty Corliss engine driving a 125 d.c. Crocker Wheeler generator, direct connected. Unit rated at 250 kw. at 100 r.p.m.

1 Cooper-Bessemer Corp. 18 by 36 Corliss engine driving a 125 v. d. c. Crocker-Wheeler generator direct connected. Unit rated at 150 kw. at 100 r.p.m.

1 Allis-Chalmers Mfg. Co. 30 by 48 heavy duty simple noncondensing Corliss engine with 125 v., 100 r.p.m. d.c. generator direct connected. Unit rated at 700 kw. at 100 r.p.m.

MISCELLANEOUS EQUIPMENT

Stop and check valves. Jenkins Brothers
Atmospheric relief valve. Cochrane Corp.
Yarway Blowoff valves.....Yarnall-Waring Co.
Safety Valves, 2 5 in., 2 4 in.....Consolidated Ashcroft Hancock Co.
Water Columns High and Low Alarm.....Yarnall-Waring Co.
Steam Traps.....Illinois Eng. Co.
Pipe Insulation 85 per cent Sectional Magnesia
Steam Gages.....Ashcroft Co.
Pump governors.....Foster Co.
Exhaust head.....Crane Co.
3 air compressors, motor driven G. E. and Allis-Chalmers motors.....Ingersoll-Rand Co.
Walkways and gratings.....Kerlow Steel Flooring Co.
Steam separators.....Crane Co.
22 in. low pressure muffle tank, oil separator capacity 770 lb. of exhaust steam per minute with 3 in. drainer.....Cochrane Corp.
Oil filters.....S. F. Bowser & Co.
Blowoff tank, complete with manhole, wearing plates and drain bypass made of Armco metal.....
Lubricators.....Richardson-Phenix Co.
Oil separator for air lines.....Swartwout Co.
Sump pump, motor driven.....Quimby Pump Co.
Thermometers..C. J. Tagliabue Mfg. Co.
Piping.....National Tube Co.

HOT WATER SYSTEM

1 Cochrane Corp. heater consisting of:

1 Copper tank 6 ft. in dia. by 12 ft. high.

1 Jet heater 32 in. inside dia. by 3 ft. 4 in. high, capacity 50,000 gal. of water per hr. from 50 deg. to 180 deg. or more.

1 Atlas Valve Co. combination thermostatic and pressure reducing valve for make-up steam line to jet heater.

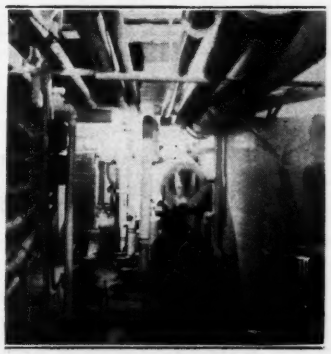
1 Cochrane 16 in. back pressure valve.

1 Atlantic Tank Co. wooden hot water storage tank 22 ft. in dia., 32 ft. high and a capacity of 80,000 gal.

1 Crane Co. 6-in. angle float valve.

2 Worthington Pump and Machinery Corp., centrifugal hot water circulating pumps, split case volute type, all bronze made, and having a capacity of 835 g.p.m. when operating against a total dynamic head of 105 ft. and 1750 r.p.m.: driven by a 30-hp. General Electric 115-v., 1750-r.p.m. compound wound motor with remote control compensators, overload and under voltage protections, push button stations and hand controlled starters.

2 Worthington Pump and Machinery Corp. centrifugal hot water circulating pumps, split case volute type, all bronze made and having a capacity of 200 g.p.m. when operating against a total dynamic head of 85 ft. and 1750



r.p.m.: driven by 7½-hp. General Electric 115-v. 1750-r.p.m. compound wound motors.

1 Worthington Pump and Machinery Corp. centrifugal booster pump, all bronze and having a capacity of 1000 g.p.m. against a total dynamic head of 70 ft. Driven by a 15-hp. G. E. 115-v., d. c., 1750-r.p.m. motor with an enclosed rheostat starter.

CONDENSATION DISPOSAL

1 High-pressure receiver 3 ft. in dia. and 12 ft. long, made of Armco metal, all seams welded, shell ½ in. thick, tested to withstand 300 lb. per sq. in.

1 Low-pressure receiver 2 ft. in dia., 6 ft. long, made of Armco metal and all seams welded.

2 Dean Brothers 9 in. by 6 in. by 12 in. horizontal durable duplex double-acting condensation pumps, 75 g.p.m.

1 Kieley & Mueller pump governor.

1 Crane Co. lift trap for condensate.

ELECTRICAL EQUIPMENT

1 Westinghouse Co. switchboard of 9 panels 90 in. high and 244 in. long carrying voltmeters, ammeters, load recording meters, equalizing switches, circuit breakers, controlling the power house and the entire Brunswick Laundry Plant.

2. Meet the demands of widely fluctuating loads without creating uneven boiler loads.

3. Assurance of uninterrupted supply with steady temperature and pressure in spite of fluctuating loads especially for the heavy morning peaks.

All of these conditions were met by a fully automatic system, designed to generate hot water at a constant predetermined rate by free use of exhaust steam and make-up live steam supplied at a uniform rate under absolute control. The principal element in this system is a Cochrane jet type heater, selected because it is peculiarly suited for large capacities, occupies small space and is comparatively low in weight and cost.

This heater consists of a 32-in. diameter jet heater proper, provided with two belts of nozzles for water inlet which are piped separately, one of which operates continuously under a normal load, while the other belt comes into action only when the loads are increased. Thorough heating of the water is obtained by spraying it in fine drops through these helically shaped nozzles. This heater has a normal capacity to heat 50,000 gal. of water per hour from 50 to 180 deg. F. or above. In order to provide a certain amount of storage for the circulating pumps and hot water supply pumps, the water is discharged into a copper tank on which the jet heater is mounted.

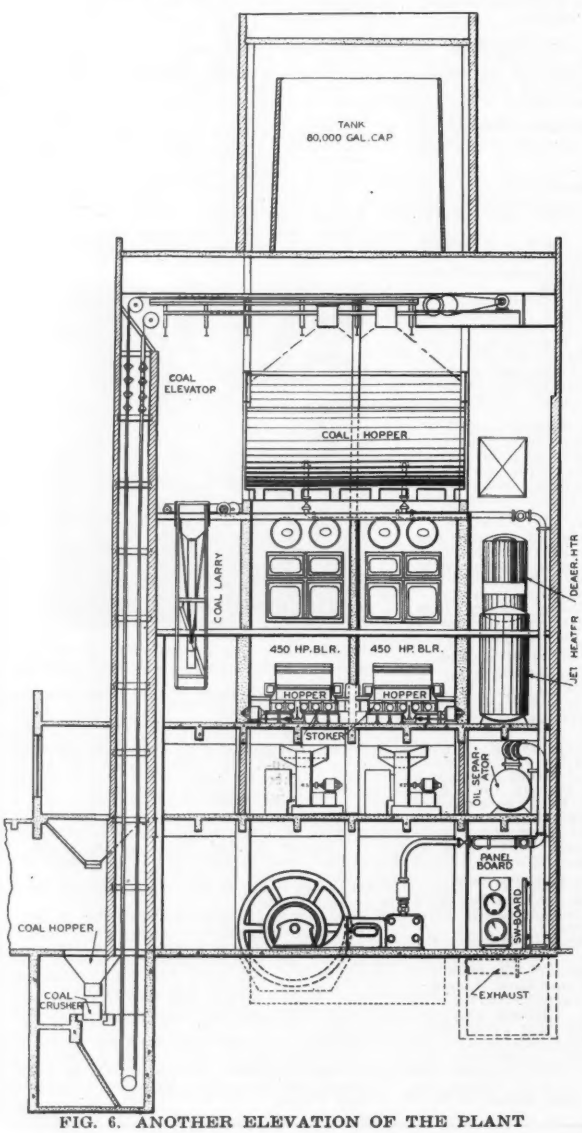


FIG. 6. ANOTHER ELEVATION OF THE PLANT

The jet heater and the boiler feedwater heater are interconnected by exhaust piping as shown on the flow diagram. The feedwater heater is a 2000-hp. Cochrane deaerating heater, provided with a two-pass, 25-sq. ft. vent condenser. It is capable of heating and deaerating 85,000 lb. of water per hr. and has a storage capacity of 95 cu. ft.

Exhaust steam is fed primarily into the feedwater heater until the water has reached its maximum temperature, then it is diverted through a 16-in. multiport valve to the jet heater. This valve holds the pressure in the exhaust line at atmospheric pressure or slightly above, automatically allowing excess steam into the jet heater. Before entering the heater, the exhaust steam is purified by passing it through a 22-in. Cochrane low-pressure muffle tank oil separator.

Whenever the supply of exhaust steam is insufficient to raise the water to the required temperature, live steam is fed to the heater. The live steam line connects with the exhaust line which inter-connects both heaters and is automatically supplied through an Atlas pressure reducing and thermostatic valve so as to step steam from 115 lb. to 5 lb. and deliver steam when the temperature of the water drops below the required degree.

After being heated and delivered to the copper storage tank referred to, the water is fed through an 8-in. line to a centrifugal pump which supplies the main 6-in. hot water line to the laundry proper or pumps surplus to the wooden reserve storage tank in the tower of the building. The importance and merits of this tank have already been referred to. During the night, one of the main generating units is run for a period of six hours for the purpose of charging the truck storage batteries. The exhaust steam thus generated is used to heat the water which is delivered to the wooden storage tank and recirculated by means of a small centrifugal pump. In this manner 80,000 gal. are accumulated during the night and are ready to meet peak loads occurring in the first morning hour operations of the laundry.

The wooden storage tank is constructed of 3-in. Red Gulf cypress staves, splined with 3/16-in. Monel Metal splines and 4-in. full length bottom with wrought iron hoops and adjustable malleable iron tightening lugs. It is 22 ft. in diameter and 32 ft. high. Cold water is fed to this tank from the top and the flow regulated by an angle float valve. Hot water is fed through the top and bottom and taken out through the bottom.

Feedwater is supplied to the boilers by two Dean Bros. horizontal duplex double acting plunger feed pumps. The water level in the boilers is controlled by Copes feedwater regulators in conjunction with Foster governors regulating steam flow at the pumps. City water is used for make up because its excellent quality makes unnecessary chemical treatment. The boilers are also fed by condensate returns from the laundry and the power plant. These returns are divided into high and low pressure groups. The high pressure returns discharge by gravity at a pressure of 80 lb. into a high pressure receiving tank located in a tunnel inter-

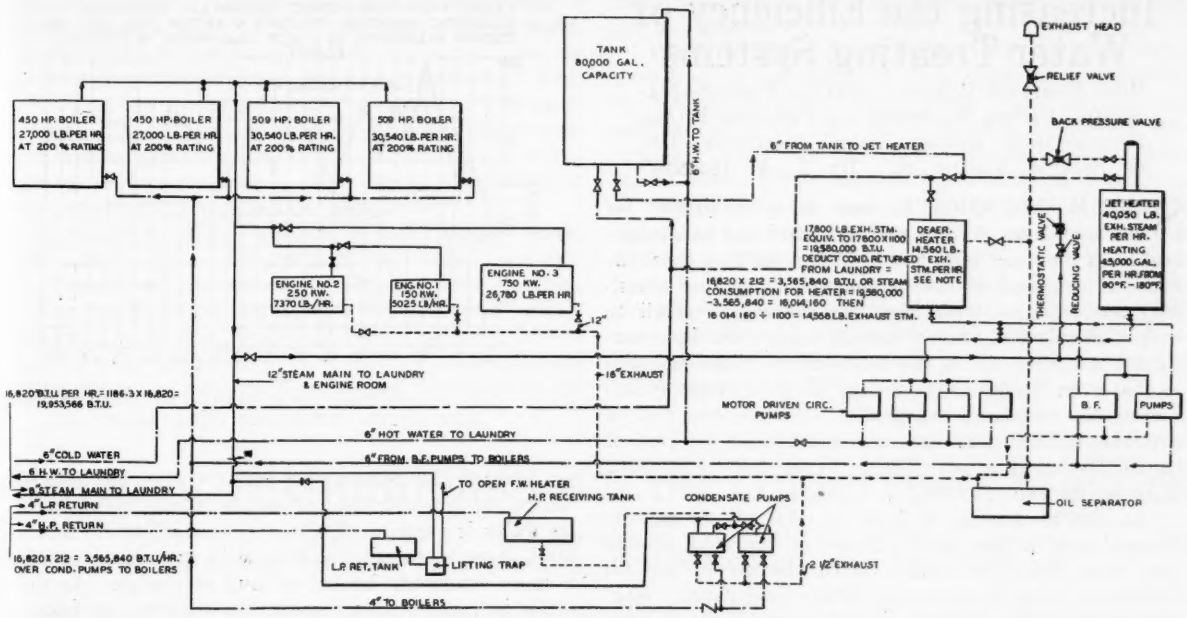


FIG. 7. FLOW DIAGRAM OF WATER AND STEAM

connecting the laundry plant with the power plant. When the level of the condensate in this receiver reaches a predetermined point, a Kieley and Mueller pump governor of the float type admits steam to the condensate pumps located under the receiver, which pump the condensate to the boilers.

All low pressure returns also drain into a receiver. The condensate from this tank, however, is lifted by Crane trap into the open feedwater heater.

Engine Room Equipment

As mentioned previously, electricity is generated by three Corliss engine driven direct current generators at about 120 v. Two of the engines are old units, having been used in the old plant for a number of years, but they are in excellent operating condition and for that reason were re-installed in the new plant.

The new unit is an Allis-Chalmers Mfg. Co. unit, 30 by 48-in., heavy duty, Corliss engine driving a 700-kw. Allis-Chalmers direct current generator. All engines, of course, operate noncondensing.

These units are placed side by side, with their longitudinal axes parallel, as shown on the plan in Fig. 3. The engine room is attractively designed, the walls and ceiling being painted white with a terra cotta wainscoting extending around the entire room to a height of about six feet. A 9-panel switchboard located in one corner of the room controls all circuits in the power plant as well as those in the laundry.

Conclusion

In the limited space available for this article, we have been able to describe only the general features and the more important details of this plant, but the same excellence which characterizes the general design extends also to every detail however small. There is, for instance the automatic electric passenger elevator. This, in this plant is a decided convenience and makes for better operation of the plant. Little also has been said of the piping, but this has received the same care in design and construction as did the design of the water heating system, or the combustion control. All headers, branches to boilers and engines, etc., and all pockets in the steam mains are dripped through Illinois bucket type traps to the two receivers in the tunnel. Each generator engine has a vertical steam separator with steam trap.

Steam connections from boilers are 6 in. in diameter and are furnished with Jenkins Bros. non-return automatic stop angle valves. Branch lines connect into headers in the boiler room and then go into one 12-in. main. This main goes to the tunnel but at the engine room ceiling branches are taken to the three engines and an 8-in. line continues down through the tunnel for the purpose of supplying process steam for the laundry.

All steam piping is wrought steel pipe, manufactured by the National Tube Co. Bends have been used for changes of alinement in preference to fittings. All piping and fittings conveying hot and cold water are of brass, the sizes going as high as 8 in. for hot water.

A complete compressed air system supplied by three motor-driven compressors forms an integral part of the plant.

From an economic as well as a reliability standpoint, this plant is a most excellent example of modern industrial power plant practice. The heat balance is such that the electricity generated can be considered a byproduct, and with the more than ample boiler and engine capacity there is little danger of a shutdown.

As intimated before, the excellence of this plant is due largely to the experience and foresight of P. O. Simeone & Co., the designers under whose supervision the plant was constructed but credit also must be given the management for their confidence in giving the engineers free rein in the design. In concluding this article, we wish to extend our appreciation to P. O. Simeone and C. K. Solski both of P. O. Simeone & Co., Inc., for their courtesy and assistance in supplying material for this article.

POWER PLANT ENGINEERING May 15 1932

Increasing the Efficiency of Water Treating Systems

MORE COMPLETE REMOVAL OF SCALE FORMING MATERIALS, FASTER REACTIONS AND IMPROVED FILTER PERFORMANCE RESULT FROM AUXILIARY USE OF SODIUM ALUMINATE. BY J. A. HOLMES*

SODIUM ALUMINATE was made available for economical use for internal treatment and as a coagulant with lime and soda ash in 1922. At that time, the material consisted of low percentages of sodium aluminate accompanied with high percentages of alkali to keep it in solution. Since that time, there has been continued improvement in the composition of the material so that even though the cost per pound of material furnished has remained practically the same, the cost of available sodium aluminate decreased to 50 per cent of its 1922 value in a year and to 5 per cent of its 1922 value by the end of 1930.

In 1920 an average of from 2.5—5.0 gr. per gal. delivered from a lime-soda softener of the cold process type was considered good. With the use of sodium aluminate, thereby obtaining better coagulation, magnesium removal and more complete reactions the average hardness expected from a cold process softener is now 1.0 gr. per gal. while some have reduced this below 0.5 gr. per gal.

At least 3 to 4 hr. was considered necessary for reaction time in any softener. While this amount of reaction time is still good practice in designing softeners, nevertheless old softeners that were called upon to produce more than their capacity have, with the aid of sodium aluminate, been able to produce a satisfactory water with not over 1 hr. reaction and settling time. This ability to speed up reactions has resulted in the prevention of pipeline, filter and pump incrustation.

Not only is the reaction speeded up and the total solids decreased but filtration is made easier because of the agglomeration of finely divided particles into a floc which filters easily. Filters can be operated longer between cleaning periods, Fig. 1 showing the improvement in one plant before and after using sodium aluminate in conjunction with a hot-lime-soda ash system.

Another advantage brought out by the development of sodium aluminate was its effect on silica in water treatment. An average of the analyses of a large number of boiler scales over a 1-yr. period showed that practically 50 per cent of these boiler scales contained from 12 per cent to 50 per cent silica as SiO_2. Sodium aluminate is the only alkaline chemical which will react for the precipitation of soluble silica, the products being calcium or magnesium aluminum silicate.

Use of sodium aluminate as a coagulant for internal treatment has proven the effect of suspended solids on foaming and on scale formation. Finely divided particles that are coagulated have less tendency to cause foam and, being in a flocculent state, flow with the natural circulation of the boiler water more easily. Sodium aluminate is rarely used alone but in conjunction with other alkaline materials which precipitate out the hardness after which they are coagulated by the aluminate treatment.

Successful treatment of boiler feedwater includes not only the control of the softening chemicals used, by tests of the make-up or boiler water, but also the control of concentration of solids in the boiler water. As water is evaporated, two types of solids are left behind, those in solution and those in suspension or what is more commonly known as mud or sludge. As these solids increase or concentrate, the tendency to foam or carryover in the boiler water is also increased. Higher concentrations are also known to have a decided effect on scale formation.

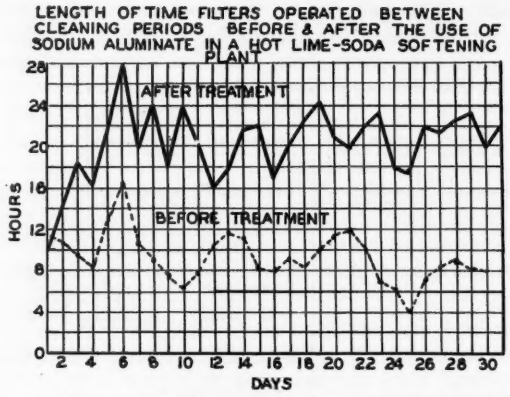

LENGTH OF TIME FILTERS OPERATED BETWEEN CLEANING PERIODS BEFORE & AFTER THE USE OF SODIUM ALUMINATE IN A HOT LIME-SODA SOFTENING PLANT
AFTER TREATMENT
BEFORE TREATMENT
HOURS
0 4 8 12 16 20 24 28
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
DAYS

FIG. 1. LENGTH OF TIME OF CLEANING FILTERS BEFORE AND AFTER AUXILIARY TREATMENT

Solids that are in solution, i.e., those that cannot be filtered out by means of filter paper, are called dissolved solids. Those solids that are in suspension and can be filtered out with a filter paper are known as suspended solids.

Control, when used to regulate concentration of internally treated boiler water, is based on proper coagulation of suspended solids by sodium aluminate. Coagulation has a marked effect on the nature and control of suspended solids. Water that contains finely divided suspended particles or has a milky looking appearance will not boil as evenly and will carryover more than water that contains large flocculent particles. By coagulation, the number of particles is reduced with a corresponding increase in size which, being in a floccuent state, as explained earlier, flow with the natural circulation of the boiler and have less tendency to flow than do the individual particles.

By referring to the chart, Fig. 2, the effect of the suspended solids on the total concentration that can be

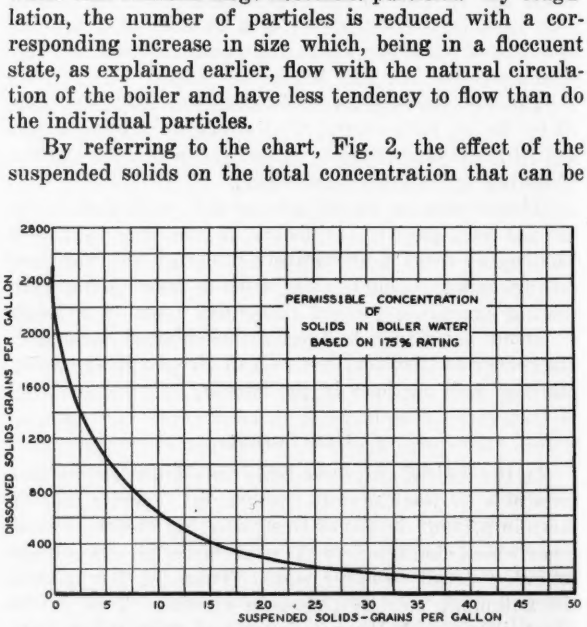

PERMISSIBLE CONCENTRATION OF SOLIDS IN BOILER WATER BASED ON 175% RATING
DISSOLVED SOLIDS-GRAINS PER GALLON
0 400 800 1200 1600 2000 2400 2800
0 5 10 15 20 25 30 35 40 45 50
SUSPENDED SOLIDS-GRAINS PER GALLON

FIG. 2. PERMISSIBLE CONCENTRATION OF SOLIDS IN BOILER WATER BASED ON 175 PER CENT BOILER RATING

*Director of Service, National Aluminate Corp., Chicago, Ill.

carried, is shown. If there are no suspended solids, a higher concentration of dissolved solid can be maintained in the boiler water without carryover. As the suspended solids increase, the concentration of total solids that can be carried rapidly decreases. The curve shown is taken from actual experience and observation in a large number of plants and acts as a guide in determining the possible concentration that can be carried at any particular point.

It was early recognized that the use of sodium aluminate was not a cure-all and that if it were to be used intelligently it was necessary that the user be thoroughly familiar with methods for checking and rapidly analyzing untreated, treated or boiler waters. Certain definite ratios are necessary to produce good results and unless there are methods for checking the water to see that these ratios are maintained, proper results can not be expected.

While, for many years, methods for analyzing water have been is use, many of these methods were beyond the facilities of the ordinary power plant engineer and consumed so much time that by the time the analysis was complete, conditions had greatly changed in the boiler room. Every effort has been made to simplify methods of testing water so that the ordinary plant engineer can make his own analyses and plans to control his treatment within a few minutes after the sample is taken. These tests consist mainly of hardness, alkalinity, chloride, sulphate, silica, alumina, total and dissolved solids determinations. Insistence that all customers use testing equipment has had much to do with making the plant engineer of today water conscious.

Burning Bituminous Coal on Underfeed Stokers

LARGER SIZE UNITS BRING ABOUT NEW PROBLEMS OF OPERATION WHICH MUST BE MET AND SOLVED IF HIGH EFFICIENCY AND RELIABILITY ARE TO BE MAINTAINED. BY BERT HOUGHTON*

INCREASE IN SIZE of the modern boiler with the demand for high rates of output has of necessity been attended by developments in coal burning equipment and methods of operation. With the adoption of radical changes in boiler and stoker sizes, a new technique of stoker operation was necessary to reduce boiler losses to a minimum at the increased rates of combustion.

From a theoretical viewpoint, combustion should take place at a rapid rate; combustion must be complete before the gases leave the furnace; progress of combustion must be so controlled that the refuse of the fuel as it is pushed off the end of the stoker must be free from combustible matter. These principles may be maintained in operation but practical difficulties may arise and certain limiting factors may be injected in operation.

Most obvious of the limitations are those of furnace wall maintenance. Further temperature limitations in stoker operation apply to the fuel bed. When the temperature of the fuel bed is properly controlled, whatever fine ash is swept up with the products of combustion does not become plastic and has no great tendency to adhere to the tubes.

One great danger to guard against is that enthusiasm over the advantages of high furnace temperatures combined with reducing flue gas temperature losses may lead to a practice of reducing the excess air to limits which on close analysis are not consistent with the best operating economy. Excess air is often controlled by analysis of flue gas samples taken at the boiler outlet. The air to fuel ratio is then set at a point slightly above the minimum at which carbon monoxide will appear. Complete analyses made on gas samples taken at the boiler outlet clearly indicate that the usual Orsat analysis taken at this point is not a safe combustion indicator.

The lower curve in Fig. 1 shows the loss due to the presence of CO in the flue gases as determined by the conventional Orsat. The upper curve shows the loss due to the presence of hydrogen and hydrocarbons in addition to CO which could not be shown with the conventional Orsat.

THIN FIRES

Since windbox pressure increases with increased resistance of the fuel bed, it is obvious that the necessary volume of air may be supplied to the stoker at a relatively lower pressure, provided a thin porous fuel bed is maintained. It has been my experience in using a thin fuel bed that the steaming capacity of a boiler can be raised up 10 to 15 per cent without reaching the smoke limit.

In developing methods for control of thin fuel beds, it was found that the resistance of the bed is still further reduced with consequent reduction in windbox pressure when a definite draft of —0.50 to —0.75 in. is maintained in the furnace. This not only lowers the point of draft balance but actually reduces the draft drop through the fuel bed for any given boiler output, lowers windbox pressure and reduces air velocity through the fuel bed. Tests made on cinder loading of the flue gas at the boiler outlet, indicate that a material saving can also be effected by operating with a —0.5-in. draft over the fire, thereby reducing the air velocity at the stoker to a minimum consistent with steam demand.

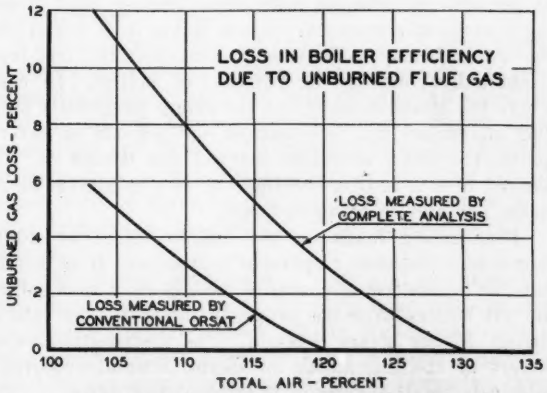


FIG. 1. LOSSES WHICH ARE NOT DETECTED BY THE USUAL ORSAT ANALYSIS

*Operating Superintendent, Brooklyn Edison Co., Inc., Brooklyn, N. Y. From a paper presented at the Third International Conference on Bituminous Coal, Carnegie Institute of Technology, Pittsburgh, Pa.

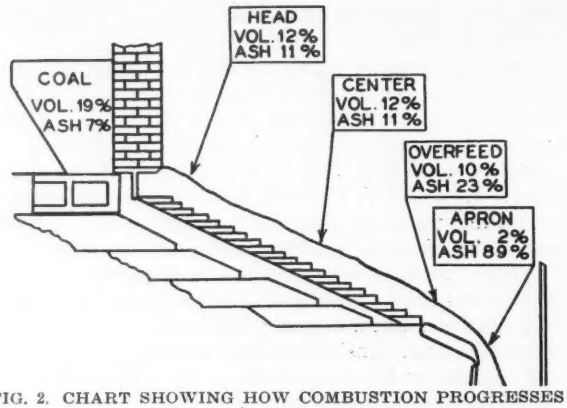


FIG. 2. CHART SHOWING HOW COMBUSTION PROGRESSES

It is not my intention to suggest that the use of a high over fire draft is the solution to the cinder loss problem, but tests show that by increasing the furnace draft the efficiency of the stoker may be materially improved.

Fuel Bed Contour

It is highly desirable to produce fairly uniform rates of heat release over the entire area of the fuel bed. Proper contour of the fuel bed must be developed and maintained. This may be determined quite accurately for each case and such work should include traverses of the gases over the fire and of fuel samples taken throughout the fuel bed. Results of fuel analyses taken on a large properly regulated underfeed stoker when firing with a comparatively low volatile coal are shown in Fig. 2. It is interesting to note that the analyses of the fuel are quite uniform down the stoker with burning out at the overfeed section and the tail of the fire.

To develop our operating practice, not only has it been necessary to set up operating standards but to bring out the methods of checking necessary for the determination of such standards and to show that by proper control of furnace draft and fuel bed the desired results may be obtained.

Even with a coal of high clinkering temperature, the operators of large furnaces must use due care in order to prevent clinker formation and consequent loss in efficiency due to ragged fuel bed conditions. Clinker will form where hot spots appear, particularly if a deficiency of air exists. When a boiler is banked, the problem is more difficult and becomes increasingly so as the time of banking lengthens. During light steaming periods of a group of boilers, it has been found that the fuel beds may be kept much more even and free from clinkers by rotating the banking of boilers. In cases where the steam demand for the group practically stops and all boilers must be banked for periods of several hours, the most advisable method for caring for the banked fires is to thin the fuel bed to a minimum as the steam demand is being reduced.

Fluctuating loads on the boilers inject an added factor into the stoker operator's problem. It is usually possible to control a group of boilers as a unit, allowing all boilers to share proportionately in the rate of change in the steam demand. The distribution to all boilers of the fluctuation in steam demand requires a relatively small change in individual fuel beds.

A true conception of the practical maximum boiler capacity has been a subject about which there has been some difference of opinion. In some cases the maximum boiler house capacity has been obtained by taking the maximum output of a clean boiler under test conditions and multiplying this figure by the number of boilers in the group. It will be found that this method will give values which are optimistic and which cannot be produced in practice. It is my experience that a much more practical method is to run a series of high rating tests on groups of boilers over a period of a week and to use the minimum of the combined maximum capacities obtained during the test periods as the measure of the maximum instantaneous capacity which the boiler house may safely be expected to produce in case of an emergency. Figure 3 illustrates this method. Steam flow charts as shown in curve A are obtained on each boiler of the group for each day of the test period. The sum of all coincident outputs of each day's test period is then plotted as shown in curve B. The lowest point of this group is taken as the safe emergency capacity of the boiler house. It is interesting to note in these tests that the maximum non-coincident output was 30 per cent higher than the coincident output used. It is evident, however, that the non-coincident output does not give a true conception of load that the boiler house can safely be expected to carry in an emergency. When such emergencies occur it is necessary to use every precaution to lessen changes on individual stokers.

It is not alone sufficient to supply accurate combustion aids but also a continuous follow-up system must be carried out utilizing the daily operating records. It is entirely possible for normal operation, including load swings in accordance with steam demands, cleaning of the fires, slagging of the tubes and banking, to reach within 0.5 per cent of maximum test economy.

Such a close approach of day by day performance to efficiencies obtained under test conditions, depends not only on a close analysis of results and vigilance in correcting faults, but also on a thorough training of the entire personnel concerned in the art of stoker operation. This should include not only an understanding of the causes and correction of defects in the fuel bed, but also the ability properly to analyze the indications of the instruments and a knowledge of the most effective means of applying corrective measures when necessary. Free discussion of all phases of the subject should be stimulated so that the details may be understood.

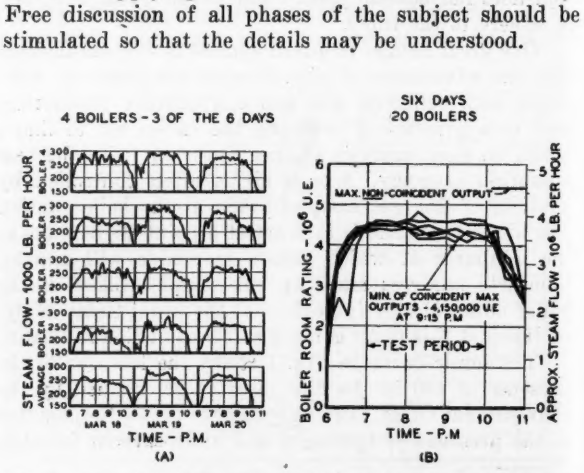


FIG. 3. TEST CURVES USED IN DETERMINING MAXIMUM STEAMING CAPACITY. A. TYPICAL HIGH RATING CURVES. B. BOILER HOUSE OUTPUT CHARTS

Power Utilization

Elevator Cable Maintenance

By C. C. Custer*

ONE OF THE duties of the maintenance engineer of a factory or office building is the inspection, operation, and maintenance of the elevators on the premises, one of the most important items being the elevator cables.

Round elevator rope is usually made of six strands of 19 wires each, the strands being twisted round a hemp core. The hemp core makes the cable more flexible and is saturated with a suitable lubricant to cut down friction between the various wires composing the strands. In the majority of elevator cables the construction is as shown in Fig. 1, which is regular-lay, right-hand rope with all the wires the same size. Sometimes we may run across what is called the Warrington-construction, Fig. 2, in which in the outside layer, every other wire is smaller, the combination of two sizes resulting in a more compact strand.

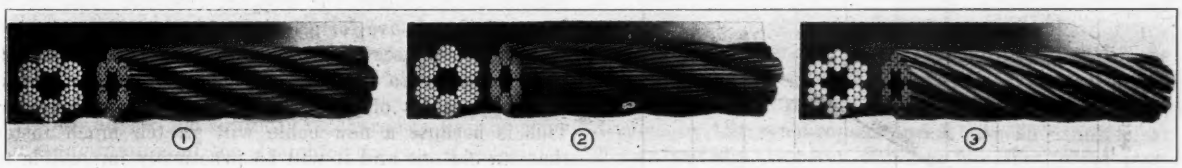


FIG. 1. REGULAR LAY RIGHT-HAND CABLE

FIG. 2. WARRINGTON-CONSTRUCTION CABLE

FIG. 3. LANG'S LAY RIGHT-HAND CABLE

Twist of the strands around the core is usually opposite to that of the wires in the strand; the twist may be to the right or to the left. This is called regular lay in distinction to Lang's Lay, Fig. 3, in which the twist of the strands around the core is in the same direction as the twist of the wires in the strand. Several times the writer has run across Lang's Lay rope used to support the counterweights of elevator cars. Its advantage is that the wires lie somewhat flatter in the grooves of the drums than for the regular lay but this construction more easily untwists than does standard rope so that any cracked wires on the outside layer are likely to fray out, catch and tear the rope to pieces; for that reason Lang's Lay is little used for elevator purposes.

Strength Requirements

Strength of elevator ropes depends on the material, three grades being in common use, iron, cast-steel and special or plow steel, increasing in order named in their tensile strength. Strength is not, however, the only consideration, as the cable must be tough to resist bending over sheaves and drums and must be elastic to resist sudden shocks. Sometimes a hard grade steel will be brittle and result in a great number of cracked wires on the outer strands. Again the use of a soft grade iron may result in excessive wear on the outer strands with few cracked wires apparent.

Experience with different types and designs of machines teaches that elevator cables must be selected to suit the especial service. For this reason the elevator code in many states requires that a metal tag be placed on all cable fastenings, upon which is stamped the size and material of the cable and the date of installation or renewal so that, in making repairs, the proper cable will be used.

Life Factors

Causes that limit the life of elevator cables are: Stresses caused by the dead load raised by the elevator or by the live load or momentum of the moving load; bending stresses occasioned by the passing of cables over pulleys and drums; internal friction of the wires of the strands on one another; external friction on the outside wires of the strands occasioned by the slipping of wires in the grooves, more particularly of the traction sheave of the traction type of elevator; and internal and external corrosion or rusting of the wires themselves.

Some of these causes of deterioration may be due to poor design and can not be remedied by the operating engineer. Again some of the causes may be partly under maintenance control. Generally speaking, internal friction is of little importance and is well taken care of by the fact that the internal hemp core is well soaked with lubricant.

Corrosion, both internal and external, is encountered in places such as ice plants, packing plants and tanneries where much moisture is in the air and especially if air is salt, as the moisture condenses on the cables unless they are kept well greased externally. Internal corrosion is a hard thing to detect as the cable strands cannot well be spread while the tension is on them in order to examine the condition of the inner wires of the strands.

Under normal conditions of wear and crackage, it is easy for the inspector to judge when it becomes imperative to call for new cables but the writer has encountered several cases where a cable looked apparently sound on the outside yet was so badly corroded internally that it broke while in service. It should be stated,

*Safety Engineer.

however, that during most of its service it had not been coated with a moisture repellant but later on dressing had been applied on the outside which made the outside wires appear in good condition. Length of life of elevator cables varies widely with the design and conditions of service, from say 10 mo. to 10 yr., the average being about 4 yr.

Suitable Grooves Are Important

Ropes must fit the grooves. U-grooves of drum type elevators should be of radius slightly larger than the rope and centers of the grooves spaced to give ample clearance, as for instance ⅞-in. centers for ¾-in. rope. Alinement of sheaves and drums should be such as to minimize wear on the sides of the grooves on drum type elevators and on the rope.

On the driving sheaves of traction type elevators, the grooves are generally V-shape so as to pinch the cable slightly to add to the tractive effort. In this type

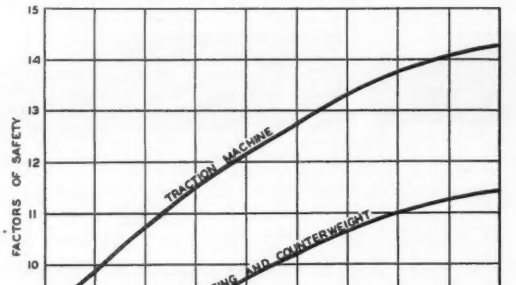


FIG. 4. FACTORS OF SAFETY FOR PASSENGER ELEVATOR CABLES

of groove there is liable to be more wear on the cables. In double-wrap type of traction machines, however, sufficient contact is made with the drive sheave so that U-grooves may be used, which promotes longer life of cables.

Most elevators are hooked up so that the ropes bend in but one direction over drum and pulleys, as reverse bending of ropes over sheaves will wear them rapidly.

Cable Fastening

For fastening of the cables at the car and counter weight end, it is always recommended that they be embedded in zinc or babbit in sockets of proper design. The proper socketing of these cables should give a strength of at least 80 per cent of the cable itself but the job of socketing is rather technical for the novice to attempt and should be left to the skilled and experienced service man. Bad socketing will create a tendency for the wires to crack just above where they come out of the socket. This is a place where cables should always be inspected for breakage.

On a drum type elevator, the hoisting cables enter the inside of the drum and are secured there by special clamps or set screws. In order to minimize the stress on these fastenings, it is required that all cables anchored to the winding drum shall have not less than one turn of cable remaining on the drum when the car or counterweight has reached the extreme limit of its travel.

In order that each of cables working in pairs or multiple on traction type machines bear its proportionate part of the load and be subject to the same wear, it is necessary to have equalizers at the point where the cables are attached. On traction type elevators it is recommended that the equalizers consist of compression springs that are adjustable in case one cable is noticed slacker than the others. These compression springs are generally found on the counter weight end of the traction cables. Equalizers may also be used at the car beam end of traction type elevators.

Sizes of elevator cables in ordinary use are ½-in., ⅝-in. and ¾-in. Larger or smaller cables than these are not recommended. It is a well established principle of design that the pulleys, drums or traction sheaves over which cables run should be at least forty times the diameter of the cables used. This would require at least a 20-in. sheave for a ½-in. traction cable or at least a 30-in. sheave for a ¾-in. cable.

When it is necessary to change a cable, it is considered necessary to change both cables of a pair, or all the hoist cables of a set in a traction type elevator. This is because a new cable will stretch much faster than an old one and it will be practically impossible to equalize the tension, unless they are of the same age and quality.

Large Factor of Safety Needed

While cables are designed nominally of strength and size to stand the weight of the car and its maximum load, at a factor of safety of 7½ to 12, varying with the speed of the car from 100 ft. per min. to 900 ft. per min. as in Fig. 4, we are really taking into account the live load momentum. With an allowable retardation force twice that of gravity, which may sometimes occur in the stopping of the car by the machine brake under a heavy load in the downward direction, we may throw a load on the cables which may be in all 3 times the dead weight or gravity pull. This will produce a much lower factor of safety than shown in Fig. 4. For instance, with a speed of 450 ft. per min., the curve shows that a factor of safety of 10 should be used but, if a total stress of three times gravity be produced as the cumulative effect of momentum, the real factor of safety during the instant of retardation is only one-third of 10 or 3⅓. This is why such apparently large factors of safety are used.

Also conditions sometimes arise from misadjustment of the elevator machine itself that may cause unusual stresses on the hoist cables. For instance, I recently inspected a car which stopped abruptly with violent shock. Going to the pent-house to investigate, I found it full of smoke from hot brake shoes. Some one had unwisely tightened the brake until it operated with much more than twice gravity retardation, which must have thrown excessive stress on the cables. Fortunately the cables were new so that no harm had as yet resulted.

When to Renew Cables

In determining when it is necessary to renew cables, wear, corrosion and broken wires are generally the limiting factors considered.

The Bureau of Mines rule says that cables of stand-

ard (6 by 19) construction shall be discarded when there are six broken wires in one rope lay or when wires on the crown are worn to 65 per cent of their original diameter, or when there are more than three broken wires in a lay, and others are reduced by wear at the crown more than 30 per cent in cross-section. Whatever rules are made, they should always err on the side of safety rather than on the side of long life for the cable. The cost of even a slight accident will almost always be greater than the cost of a new rope.

Another check on the useful life of a cable is to keep account of the stretch of the cable during its life. New cables stretch rapidly during the first few months' use; then the stretch slowly decreases. When the stretch almost ceases, we may correctly assume that the individual wires are approaching their limit of elasticity or in other words, when a cable ceases to stretch in service, it is getting ready to break.

Recently I ran across an old elevator supported by a single ¾-in. cable which had eight cracked wires per strand and the suggestive part of it was that the cracked ends were gaping apart perceptibly so that one could imagine that complete breakage was imminent.

Points to Check

It is well for the engineer in charge to keep a periodic memorandum of the stretch of the cables, especially for a traction type machine. If the cables stretch until there is danger of the counterweights resting on their lower stops when the car is at the top landing and before the car reaches the upper limit switches, the machine may keep turning and wear the cables to a dangerous extent. Most modern type traction machines within tall shaftways are nowadays equipped with a lower limit switch, operated by compensating cables in case the counterweights get to hanging too low due to cables stretching. This cut-out calls attention to the necessity of shortening the hoist cables.

Cables do not always show the same wear throughout their length. Traction cables generally show most wear at the part that passes over the sheave when the car is at the bottom landing, because, at this point, most of the heavy loads are started, hence more slippage and wear of cables are produced at this point.

If traction cables show excessive crown wear with little breakage of individual wires, it is well to check up the condition of the V-grooves in the traction sheave. These grooves may be so worn that they no longer grip the wire properly and excessive wear is coming from the unusual amount of slippage. The remedy would be to recut the grooves.

In conclusion, short life of cables is generally caused by poor design, too small diameter of pulleys, drums or sheaves, lack of care in selection of cables to fit the conditions, poor adjustment of machines, lack of attention to keep cables lubricated and to protect them from moisture and corrosion.

We have in mind an automobile type of freight elevator which has but three traction hoist cables whereas this type of design usually calls for the use of six ⅝-in. cables. The result is that a set of cables lasts no longer than one year. In another case of a drum type elevator, part of the cables are hooked up so as to be subject to reverse bending. These particular cables need replacing inside of a year from installation, on account of the excessive crackage.

Many modern installations of traction double-wrap type, U-groove sheaves have field control type of d.c. drive, which permits of dynamic braking, giving smooth acceleration and slowing down of the speed to keep sudden shocks and stresses off the cables. In spite of the high speed of operation, cables on this kind of outfit may last in constant service from 8 to 10 yr. It is well for the engineer in charge to keep a memorandum of the date of installation of his cables and a log of the stretching and crackage experienced, so that he may determine whether he is getting the life and service of cables that he may properly expect with the type of elevator he has in use.

Irregular Motor Speed

When the load on a 20-hp., slip-ring induction motor is varied with the speed, running from 5 hp. at high speed to 25 hp. at low speed, the irregular speed at the heavy load cannot be corrected by a different controller. The method of speed control by introduction of resistance into the rotor circuit, is similar to speed control of a direct-current motor. Lowering of the speed is accompanied by a material lowering in the efficiency and poor speed regulation. The electrical efficiency of the rotor is equal to the actual speed divided by the synchronous speed. As an example, at 25 per cent slip the rotor efficiency is under 75 per cent. In other words, of the power transmitted across the air gap, 25 per cent is lost as heat in the rotor resistance. Because of rotor friction and core losses, less than the remaining 75 per cent is converted into mechanical energy at the pulley.

For individual drive on isolated machines requiring variable speed, the best type of induction motor is one with a wound rotor. This type of motor has better starting characteristics but poorer running characteristics than the squirrel cage motor. Wound induction motors are used where considerable starting torque is required and frequently where speed adjustment is desired. The most common applications of this type are in cranes, elevators, pumps, hoists, railways and in the electrical propulsion of ships.

Ossining, N. Y. Edward W. Johnston.

For the city of Aberdeen, S. D., a Diesel municipal plant is proposed as a result of a survey recently completed by Bemis Co. of Chicago. The plant suggested would have four 4000-v., 3-phase, 60-cycle units of 4000 to 4500 kw. total capacity, estimated cost of the plant to be $520,400. Distribution and street lighting systems are estimated to cost $330,500. Adding materials, supplies and cost of capital, the total estimated cost would be $884,900. To deliver the present supplied load of 8,445,900 kw-hr. a year and expected increase, two units of 835 kw. each and one of 1285 kw. are proposed with an additional 1285-kw. unit in 1935.

With fuel oil at 4.5c a gallon, Bemis Co.'s estimate of delivered cost of energy is 2.651c per kw-hr.

Our attention has been directed to an error which unfortunately was contained in the review of the book "The Nature of a Gas" by Dr. Leonard B. Loeb, published by John Wiley and Sons, Inc., which appeared on page 319 of the April 1 issue. The price of the book should have been listed as $2.50 instead of $4.25 as it appeared in the review.

POWER PLANT ENGINEERING May 15 1932

Service Water Heater Essentials

By W. J. O'Brien*

IN THE WAY of constructive suggestion as to the article on p. 208, March 1 issue, one of the most important essentials overlooked is water circulation. In the figure reproduced herewith, Fig. 1, the arrangement is approved in most of the features but the manner in which the water connections are made is actually wrong and there are other auxiliaries I consider important. Also there are better types of equipment in the writer's opinion to assure most satisfactcry results.

Inlet for the cold water is connected to the bottom of the tank, close to the heating element inlet and the hot water connection is taken from the top and back of the tank opposite the heating element inlet. This is contrary to the principles of heat exchange, as the cold water should be connected to the point where the temperature of the heating medium would be reduced, that is at the opposite end from the heating element inlet. Then the hot water should be taken from the top front over the heating element, as in Fig. 2, to avoid expansion strains which shorten the life of tubes and shell.

More important, however, is the fact that uniform control of water temperature in such an arrangement is impossible, due to the fact that the heat circulation is away from rather than around the thermostatic bulb.

Just recently, on a service call to determine the trouble with a Sylphon temperature regulator, I found an installation almost identical to that shown in Fig. 1, approved on a state prison job, with storage heaters furnished by a leading heater manufacturer. A mercury thermometer was installed near the hot water outlet connection and temperature was indicated as nearly 200 deg. F. The steam valve of the temperature control was still open, even though the regulator was set for about 160 deg. F. We felt with our hands of the temperature surrounding the thermostatic bulb of the temperature regulator and we all agreed that the temperature at that zone was less than 100 deg. F. Just trace the normal circulation in Fig. 1 to learn the reason.

Added Equipment

Additional auxiliaries which I recommend are: First a thermometer to show the temperature of the water near the outlet; second, a water relief valve, either a pressure relief or preferably a practical combination pressure and temperature relief valve; also a strainer ahead of the temperature regulator valve is recommended. I approve of the vacuum breaker between temperature regulator and heater inlet, the vent valve on the outlet and the drip trap on the supply to the regulator. In reference to better methods and types of equipment, for removal of condensate I prefer a float type trap, of ample capacity to take care of peak momentary loads, rather than of hourly average as is usually used. A thermostatic vent valve in combination is desirable.

*Steam Specialist, Syracuse, N. Y.

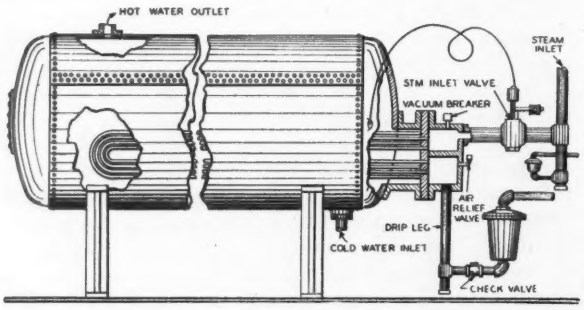


FIG. 1. THIS HEATER ARRANGEMENT IS CRITICIZED

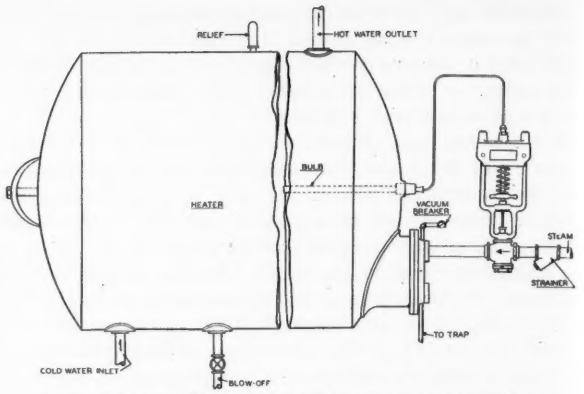


FIG. 2. CONNECTION FOR PROPER CIRCULATION

Size of Temperature Regulator

In determining the temperature regulator, almost invariably the selection is oversized, unless such factors are considered as capacity requirements in pounds per minute or gallons per hour, steam pressure and temperature rise of water. An oversized valve will permit overheating due to excessive leakage during low capacity or no draw periods. The wire drawing will wear the valve excessively, shortening the life and normal service of the regulator.

In my opinion, although the conventional storage type of heater is almost universally accepted as standard, there is a far better method of securing results.

Storage Tank and Instantaneous Heater

The storage tank, assumed as 400 gal. capacity is considered as holding almost 400 gal. of hot water where actually, due to stratification and poor circulation in the tank, nearly half of the capacity is at less than the desired temperature, with the water below the heating element almost cold.

Frequently it happens when a sudden heavy draft of water is made, that, due to pressure drop across the water inlet to water outlet connection, cold water can

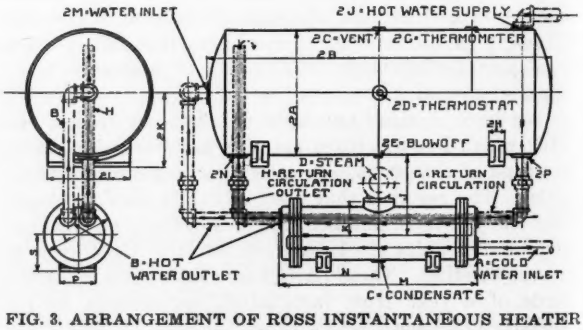


FIG. 3. ARRANGEMENT OF ROSS INSTANTANEOUS HEATER AND STORAGE TANK

TYPE OF BUILDING	FIXTURE: Dish Washer	Pantry Sink	Kitchen Sink	Slop Sink	Wash Basin - Private	Wash Basin - Public	Bath Tub	Shower Bath	Foot Basin	Lavatory Tap Stationary	Lavatory Tap Revolving	Wash Racks	% Heater Capacity	% Storage Capacity
	MAXIMUM GALLONS PER HOUR PER FIXTURE													
Apartment House	15	10	10	20	3	5	15	50	3	25	75	30	20	100
Church	..	..	..	10	..	5	..	100	..	..	..	..	80	50
Club	30	20	20	20	3	8	15	200	3	35	75	..	50	75
Department Store	..	..	..	20	3	8	..	..	..	..	..	..	50	75
Depot	..	..	..	20	3	10	..	100	..	..	..	..	60	50
Dormitory	..	..	..	15	3	10	30	200	3	35	100	..	75	50
Garage	..	..	..	..	3	12	..	150	..	..	..	50	80	50
Gymnasium	..	..	..	..	3	10	30	200	12	..	..	..	80	50
Hospital	30	20	20	20	3	8	15	50	3	35	125	..	60	50
Hotel	30	20	20	30	3	10	15	50	3	35	150	..	50	25
Industrial Plant	30	..	20	20	3	15	30	200	12	..	..	..	90	50
Laundry	..	..	..	10	3	10	..	..	..	40	150	30	100	25
Loft Building	..	..	..	20	3	10	..	150	..	..	..	..	80	50
Office Building	..	..	..	15	3	8	..	..	..	..	..	..	15	100
Public Bath	..	..	..	15	3	15	45	200	..	..	100	..	100	50
Residence	..	10	10	15	3	..	15	50	3	25	75	..	50	100
Restaurant	300 Gallons per 500 people per hour												50	75
School	15	20	10	20	3	18	..	200	3	..	..	..	25	50
Theatre	..	..	..	15	3	5	..	..	..	..	..	..	75	75

FIG. 4. TABLE FOR VARIOUS HOT WATER REQUIREMENTS AT 180 DEG. F.

be drawn from the tank even though there is hot water in other portions of the tank.

With the heating element submerged in the water, there is a definite pressure drop through it during peak demands. Water may accumulate in the tubes, reducing heating capacity and, unless trap capacity is ample to handle surges of water, drainage of condensate and elimination of air from the heating section will be difficult.

During the period of no draft of hot water, there is no circulation in the heater except by radiation and convection, which is very slow.

Most satisfactory as a solution to this problem is a combination storage tank and instantaneous heater with a positive circulating connection such as is shown in Fig. 3. This arrangement assures that the water taken from the hot water connection must first pass through the heater section, then across the tank length. Circulation is provided, even when no water is being drawn. There is a minimum pressure drop in the steam jacketed heater, assuring easy, positive drainage, the price is usually no more than for the contained heater type and, in case additional water heating is needed, it is easy to add another instantaneous heater or increase the size of the first one without disturbing the tank. Herewith is a table for estimating hot water capacity requirements, Fig. 4, and a suggested method of determining tank and heater size.

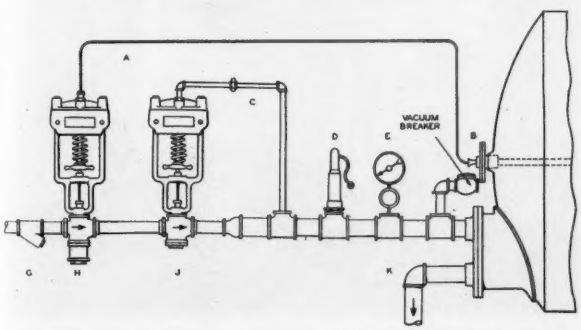


FIG. 5. ARRANGEMENT AND CONNECTION OF REGULATORS WHERE HIGH-PRESSURE STEAM IS USED

The table gives customary allowance of hot water at 180 deg. for various fixtures and buildings, columns at the right showing the provision of capacity needed in heater and storage tank shells. For instance in an industrial plant having two slop sinks, two private and 20 public wash basins, five showers, the requirements would be: $2 \times 20 = 40$ g.p.h.; $2 \times 3 = 6$ g.p.h.; $20 \times 15 = 300$ g.p.h.; $5 \times 200 = 1000$ g.p.h.; total 1346 g.p.h. Heater capacity $= 0.90 \times 1346 = 1211$ gal.; storeage capacity $= 0.50 \times 1346 = 673$ gal. The storage tank would be say $3\frac{1}{2}$ ft. diam. by 9 ft. long and heater for 20 lb. steam pressure 15 in. diam. by 5 ft. long to heat 1255 g.p. hr.

High-Pressure Heater

Typical connection diagram, Fig. 5, shows how connections should be made to a heater when high-pressure steam is used. In the usual method, the pressure regulator is installed to reduce the pressure to the temperature regulator and the temperature regulator is selected on the basis of the lower pressure; then, when the temperature regulator is subjected to "dead and service," the pressure between the temperature and pressure regulators builds up and leakage of balanced valve on the the temperature regulator increases. The tank is overheated, the pressure relief valve pops and both temperature regulator and pressure regulator are condemned. The sketch shows the correct procedure, with temperature regulator H on the high-pressure side of the pressure regulator J.

Modern Power Station Boiler Practice In France

M. Rauber of the Union d'Electricite, which supplies the French capital with electrical energy, has recently made public some details of the latest boiler practice at the new power producing plants in the Paris area. The Vitry (South) power station which has been in commission for several months has become the true base load station and the old station at Gennevilliers more of a peak load and stand-by plant. The two boiler houses differ in design to suit these different conditions. The Vitry (South) boiler house contains two boilers, each for 240,000 lb. per hr. economical rating and 300,000 lb. per hr. maximum, at a pressure of 500 lb. and a temperature of 840 deg. F. At Gennevilliers, capital cost was more important. Each of the new boilers is designed for 240,000 lb. per hr. economical and 300,000 lb. per hr. emergency rating, the pressure being raised from 350 lb. at 700 deg. F., to 425 lb. at 750 deg. F. Combustion chamber walls are a combination of refractory material and water cooling, whereas at Vitry (South) completely water-cooled walls are adopted. Efficiency of the boilers at Gennevilliers is slightly over 85 per cent with CO_2 content of 14 per cent and a temperature to the stack of 290 deg. F.

POWER PLANT ENGINEERING May 15 1932

Ice Plant uses HYBRID DIESEL Compressor Unit

PLANT OF THE KNICKERBOCKER ICE CO., LONG BEACH, N. Y., HAS NOVEL COMPRESSOR UNIT AND MANY INTERESTING FEATURES

ONE OF THE RECENT PLANTS that is certain to have an important bearing on ice plant design of the future is the Long Beach, N. Y., plant of the Knickerbocker Ice Co. This plant, using a novel combination of Diesel engine and ammonia compressor, has a nominal rating of 60 t. of ice but has averaged 68.4 t. of ice per 24 hr. with a fuel oil consumption, for one month, as low as 3.3 gal. per t. of ice produced.

A plan of the station is shown by Fig. 3. The loading platform, delivery room and office, built as a sales station in 1929, were arranged so that the ice manufacturing section could be added later. The delivery room has a floor area of 1466 sq. ft. and is equipped with a benching machine for stacking ice four tiers high. The building, single story in height, is supported on piles because of the poor soil conditions. For the same reason, the fuel oil storage tank is above ground. The building occupies about 6000 sq. ft., leaving about 2000 sq. ft. on the plot for a future ice storage room.

The engine-compressor unit shown by Fig. 1 consists of a high standard six-cylinder engine frame on which has been substituted, for two of the oil engine cylinders, two vertical single-acting ammonia cylinders. The unit, therefore, consists of four 15 by 18 in., four-cycle, solid injection Diesel cylinders rated at 235-b-hp. at 220 r.p.m. and two 10 by 18-in. dual effect ammonia cylinders. A section of the engine and compressor is shown by Fig. 4 with a detail of the ammonia suction and discharge valves included. A single shaft and flywheel serves both engine and compressor. Auxiliary power is furnished by a 70-kv-a., 0.8 p.f., 2-ph., 60-cycle generator belt driven from the flywheel. The connected auxiliary load is 25 hp. in motors and 1 kw. in lights with an average daily electrical consumption of about 350 kw-hr.

COMPRESSOR CYLINDERS MAKE LITTLE CHANGE IN ENGINE

As shown by the section, Fig. 4, regular cylinder liners in the two compressor cylinders act as crosshead guides so that standard connecting rods can be used with little change. Compressor cylinders are cast with neck pieces, with openings for adjusting stuffing boxes, so designed that they may be substituted for the regular cylinder head and still use the standard cylinder head studs. All compressor valves are located in the cylinder as shown by the detailed drawing. Weights of the reciprocating parts are made the same as in the Diesel engine so as to obtain the proper balance. In case of excessive head pressure, the fuel supply to the engine is cut off after sounding suitable signals to warn the operator and give him a chance to remedy conditions.

Foundation consists of thirty 40-ft. piles driven on 3-ft. centers and capped with 12 in. of concrete. This was topped by 4 in. of natural cork before pouring the regular foundation with 2 in. of compressed cork on the sides.

City water is used for ice making after treatment with sodium aluminate and aluminum sulphate and fil-

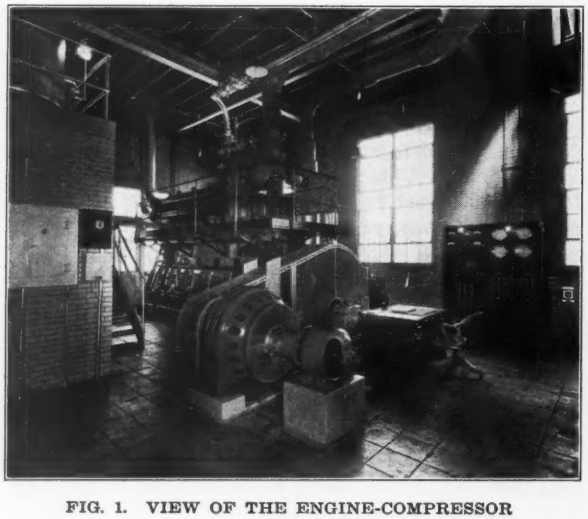


FIG. 1. VIEW OF THE ENGINE-COMPRESSOR

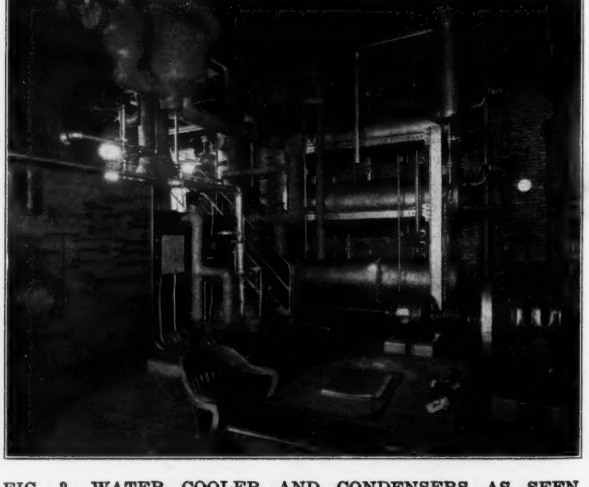


FIG. 2. WATER COOLER AND CONDENSERS AS SEEN FROM THE SWITCHBOARD SHOWN IN FIG. 1

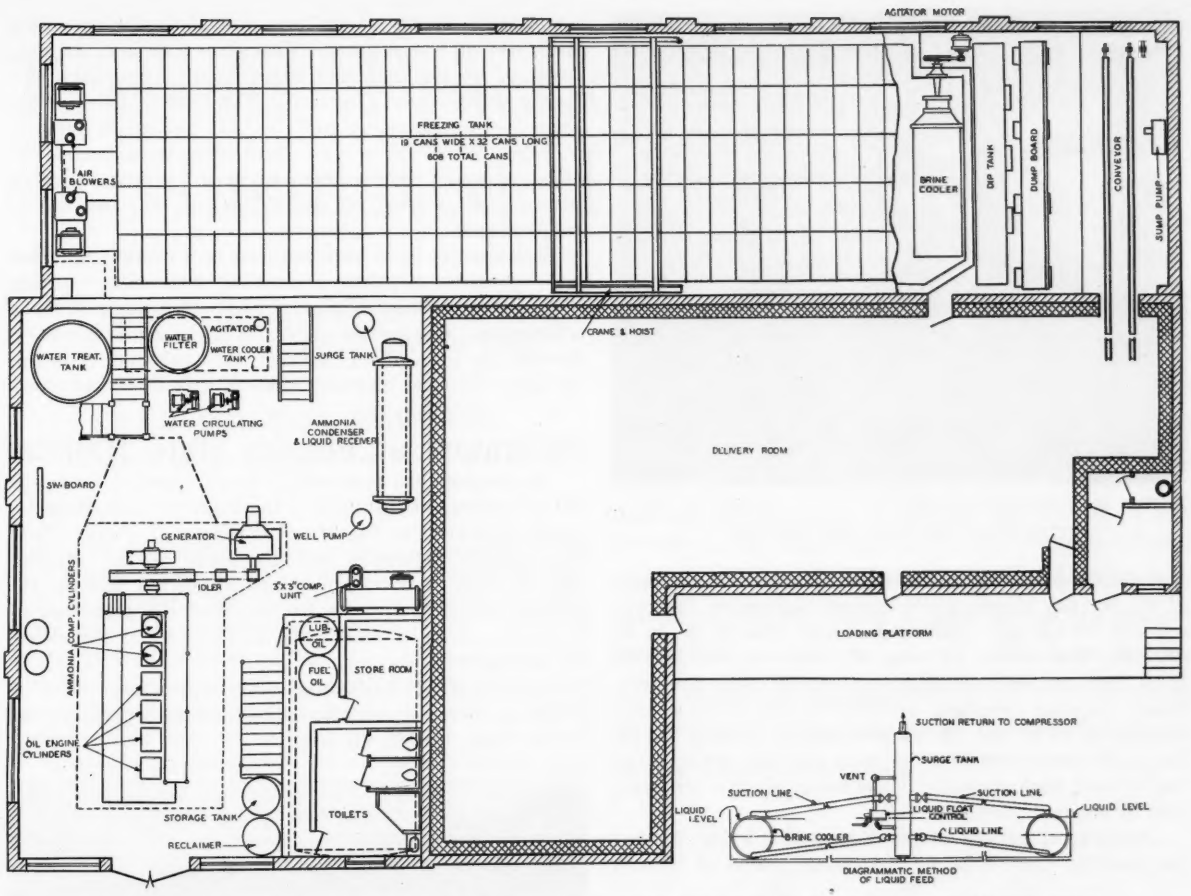


FIG. 3. FLOOR PLAN OF THE PLANT WITH AN INSERT SHOWING THE METHOD OF LIQUID FEED

tered through sand on the way to the forecooler. The forecooler with three trunk type cooling coils operated at the high suction pressure cools the water to about 40 deg. F. before it is pumped to a surge tank by a 30-g.p.m. pump. The can filler and corefiller are fed by gravity from this surge tank.

Two 412-sq. ft., 2-pass shell and tube ammonia condensers 33.25 in. dia. by 11 ft. long are installed as shown by Fig. 2. The ammonia receiver directly below is 30 in. dia. by 11 ft. long. Cooling water is pumped from a deepwell by a 300-g.p.m., 70-ft. head pump driven by a 15-hp. motor.

Two Brine Coolers Used with Single Liquid Control

Freezing tank with a total of 608, 11 by 22 by 51-in. cans in 32 rows has two single pass shell and tube brine coolers each with 3000 linear feet of No. 9 B.W.G. 2-in. steel tubing. One cooler is located in each end of the tank as shown by the insert in Fig. 3 with a single float valve and vertical accumulator serving both. Liquid ammonia is cooled by a forecooler.

Ice is harvested by a 5-t. crane, capable of lifting 19 cans at a time. From the dump, ice is passed to a double chain conveyor and is carried to the delivery room. Can water is agitated by the low-pressure mechanical pendulum system using 2-lb. air supplied by two centrifugal blowers rated at 400 c.f.m. each and driven by 7½-hp. motor.

Delivery room walls are insulated with 12-in. of regranulated cork and the roof with two layers of 3-in. sheet cork laid in hot asphalt. The floor consists of 1 by 6 in. red oak planks laid on 3 by 4 in. pine sleepers set in 2 ft. of tamped cinders.

Performance during the short period the plant has been operating is exceptionally satisfactory, the average

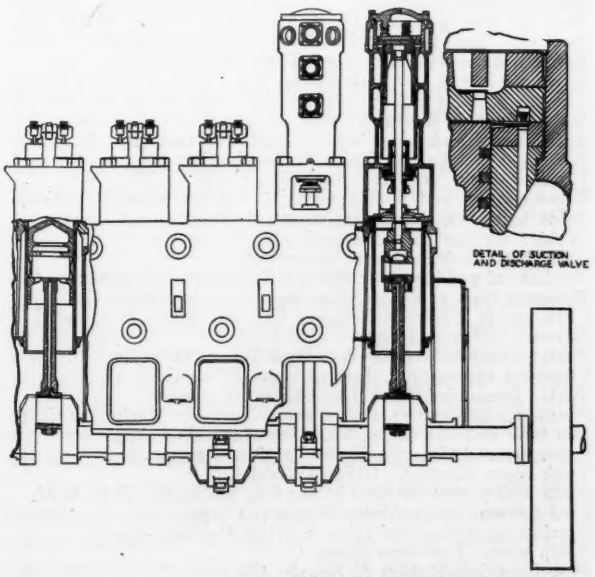


FIG. 4. ELEVATION AND PARTIAL SECTION OF THE ENGINE AND COMPRESSORS WITH DETAILS OF THE AMMONIA SUCTION AND DISCHARGE VALVES

FIG. 5. TOP OF THE FREEZING TANK LOOKING TOWARD THE DIP TANK AND CAN FILLER

fuel consumption for the month of August being 3.6 gal. of oil per ton of ice, while during September this was reduced to 3.3 gal. Oil used ranges around 28 to 31 deg. Be., flash point 163 deg. F., heat content 142,000 B.t.u. per gal. with sulphur content of 0.409 per cent. Head pressure averages around 134 lb. with a high suction of 40 lb. ga. and a low suction of 18.5 lb. ga. The high temperature plane cools the can water to 40 deg. F. and flash cools the liquid ammonia to a temperature of about 27 deg. F.

Brine temperature averages around 9.4 deg. F. and the freezing time is 32 hr. Although rated at 60 t. a net salable output of ice per day of 68.4 t. has been made during hot weather. This gives a ratio of 8.4 cans per t. of ice and less than 40 sq. ft. of brine cooler surface per ton of ice produced. The heat transfer in the brine coolers ranges up to 77.3 B.t.u. per sq. ft. per deg. F. temperature difference. Dual effect ports reduce the effective piston displacement by 5/8 in., giving an actual piston displacement of about 9500 cu. in. per ton of ice produced.

Labor costs have been reduced to a minimum. Normal operation requires a crew of floor men working 8-hr. shifts; a chief engineer, two watch engineers and a tankman. During the night shifts, the watch engineers harvest the ice; during the day, the tank man does this to allow the chief engineer time to look after the plant.

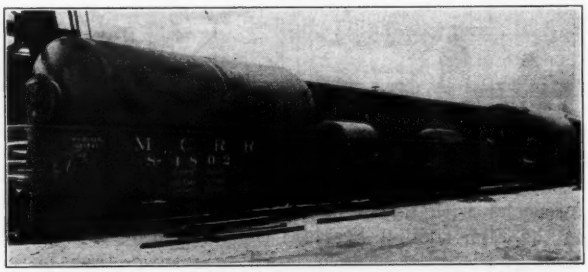
Equipment in Long Beach Plant

Engine, I. P. Morris & De La Vergne, Inc., 235 hp., 220 r.p.m., 4-cyl., vertical, 4-cycle solid injection Diesel engine, arranged integral with two vertical 10 by 18 in. ammonia compressor cylinders, complete with 45 gal. lubricating oil reclaimer.
Generator, Electric Machinery Mfg. Co., 70 kv.a. 0.80 p.f., 220 v., 2 ph., 60 cycle.
Fuel Oil Storage Tank, Leetonia Boiler Works, 10,000 gal.
Fuel Oil Tank Gauge, King-Seeley Corp. telegauge.
Exhaust Line Thermometers, The Foxboro Co.
Fuel Oil Pump and Lubricating Oil Pump, 2 Viking Pump Co., 3/8 in., 3½ g.p.m., driven by Westinghouse ¼ hp. motors.
Isolation Cork, Korfund Corp.
Switchboard and panel boxes, Empire Switchboard Co.
Electrical installation, Robt. E. Denike, Inc.
Freezing tank, York Ice Machinery Corp.
Brine coolers and float controls, York Ice Machinery Corp.
Brine agitators, Ole G. Halvorsen Co.
Welded ice cans, Knickerbocker Stamping Co.
Can grids, Knickerbocker Stamping Co.
Mechanical pendulum air system, Knickerbocker Stamping Co.
Pressure type can filler, Knickerbocker Stamping Co.
Core pump, Nash Engineering Co., 50 g.p.m., 30 ft. head.
Blowers, Allen & Billmyre Co., Inc.
Water treatment tanks, Woolford Wood Tank Co.
Chemical apportioner, International Filter Co.
Water forecooler, York Ice Machinery Corp.
Ammonia condensers, and receiver, York Ice Machinery Corp.
Dip tank and can dump, York Ice Machinery Corp.
Crane, Euclid Crane & Hoist Co., 5 t., 2-motor.
Tank room conveyer, Gifford-Wood Co.
Deep well pump, Sterling Pump Co., 300 g.p.m., 70 ft. head.
Cold storage doors, Victor Products Corp.
Scoring machine, Perfection Scoring Machine Co.
Sump pump, Davidson Pump Co.
Pipe Covering, Robert A. Keasby Co.
Benching machine, Lewis-Shepard Co.
Forecooler pump, Weinman Pump Co., 30 g.p.m., 30 ft. head.

Separators at Pilgrim State Hospital

Attention has been called to an omission from the list of equipment installed in the Pilgrim State Hospital which appeared in the March 15 issue of Power Plant Engineering. Mention was not made of the Wright-Austin steam and oil separators which are used in the piping system, the entire list supplied the plant being:

2—2½-in., 3—4-in. and 5—10-in. Type A vertical steam separators.
2—10-in. Type B horizontal steam separators.
2—16-in. Riveted steel horizontal steam separators, 48 in. diam. by 102 in. long.



LARGE SEPARATORS WHICH ARE NOW INSTALLED IN PILGRIM STATE HOSPITAL

2—30-in. Welded steel horizontal oil separators, 8 ft. diam. by 12 ft. long, each for 9000 hp. exhaust steam.
1—24-in. Welded Type S oil separator, 72 in. diam. by 32 in. face to face.

That some of these separators are of mammoth size is evident from the accompanying illustration showing the shipment as it was ready to leave the factory.

According to a recent report a new protected metal called Robertson-Bonded Metal (R-B-M) has been carried through the laboratory stages of development at Mellon Institute of Industrial Research. Copies of this report, giving complete information concerning this new material, may be obtained by applying to Mellon Institute, Pittsburgh, Pa. This is a laminated metal-felt material in which felted materials are cemented to steel with heat and pressure, utilizing metals as adhesives. It is possible to choose between a number of felts and felt saturants to stand against various corrosive conditions. The ductile nature of the metal bond between felt and steel makes it possible to subject this material to forming operations

Present Practice in Insulated Power Cables

A Picture of the status of the Underground Cable Art today

By DONALD M. SIMMONS
General Cable Corp., New York, N. Y.

The art of transmitting electrical power has developed to a high stage of perfection in recent years, particularly in the underground cable field. It is a far cry from Edison's wooden conduit at Pearl Street to the modern 132 kv. oil filled underground cable of today. . . . The entire story of underground cable development would require a book; enough of essential facts are presented in this short article to give the reader a good idea of the present status of the cable art. . . . This is an abstract of an article which appeared in the February number of Electrical Engineering of The American Institute of Electrical Engineers.

IN CONSIDERING power cables, we naturally think of three types of insulation: rubber, varnished cambric, and paper. The general characteristics of these three types are presented in Table I.

In determining the quality of rubber compound for insulation, the tests used formerly were based upon a chemical test for certain ingredients. It has been found, however, that tests which show the actual performance of an insulating compound are far more valuable than one which indicates the ingredients and so a number of such tests have been devised which simulate service conditions and prove that one insulation will have a much longer life than another. In the Greer test, samples are suspended in an oven at 158 deg. F. and hot fresh air is allowed to circulate.

Another test, the oxygen-bomb test, usually considered superior to the Greer test, is based on the fact that deterioration in rubber compound is usually due to oxidation. The samples are placed in a bomb filled with oxygen under 300 lb. pressure at 158 deg. F. A third test subjects the compound to the action of ozone. Typical curves obtained by the oxygen bomb test are shown in **Fig. 1.**

Varnished cambric has a higher dielectric loss than that now obtainable with paper, and due to the method of manufacture contains some air and moisture. The present trend is toward a reduction in the dielectric loss as well as a different application of the tapes so that wrinkles and voids will be largely eliminated. Many years ago it was found necessary in the manufacture of paper cable to apply the paper tapes so that they butted instead of overlapped. Only recently has this been used with varnished cambric.

TABLE I. CHARACTERISTICS OF CABLE INSULATIONS

	Rubber	Varnished cambric	Paper
Moisture resistance	Very high	Fair	Hygroscopic
Max. allowable temperature	60 deg. cent.	75 deg. cent.	85 deg. cent.
Can be bent to	6 diam.	8 diam.	12 diam.
Affected by corona or ionization	Yes	Resists	Resists
Life	Fair	Long	Long
Power factor 60 deg. cent.	5%	6%	1%
Installation and jointing	Very easy	Easy	Requires care
Can be used non-leaded	Yes	Yes (indoors)	No
Dielectric strength in volts/mil for 1 hr.	250	250	400
Standard test voltages in volts/mil	70	125	200
Specific inductive capacity	3.5 to 6	3.5 to 6	3 to 4

Varnished cambric when leaded is more costly than paper and rarely is used for underground transmission. For station work, however, it is sufficiently resistant to moisture to operate without a lead sheath and terminals, and thus varnished cambric braided cable often has considerable advantage in cost over other forms. Table II shows recommended types of insulation for station cable.

Impregnated-paper insulated cable is used universally for underground transmission of large blocks of power and for high voltage work. It is not only the least expensive type of cable available for this purpose, but also it has by far the highest dielectric strength, longest life and greatest reliability. For voltages of 33 kv. and over, it is at present the only type which can be used successfully and economically.

Up to a few years ago, multi-conductor cables were mostly of the belted type, a cross section of which is shown on the left in Fig. 2. These cables proved fairly satisfactory for voltages up to 26 kv.; however, when it was attempted to use this construction at 33 kv., the belted cable was found entirely inadequate unless very

TABLE II. INSULATION RECOMMENDED FOR STATION CABLES

Nominal system voltage		Preferred insulation for non-leaded cables	
From	To	First	Second
0....	600 ..	Rubber	
601 .	4,000 ..	Rubber ' ..	Varnished cambric
4,001.	13,200 ..	Varnished cambric	Rubber
13,201..	17,000*..	Varnished cambric	Paper (lead-covered)

*At voltages higher than 17,000 volts, paper-insulated lead-covered cables should be used.

heavy walls of insulation were used. The difficulty, it seems, had to do with the unavoidable creation of voids in the filler spaces between the conductors.

A solution to the difficulties, however, was obtained by Martin Hochstadter, who invented the type "H" cable, which is shown in the middle of Fig. 3. This design with a metal foil enclosing a conductor insulation prevents all the trouble of the belted cable because the filler spaces are completely shielded from electrical stress. It also has considerably greater current carrying capacity. Being electrically equivalent to three conductor cables under a lead sheath, it can be operated at the higher temperatures permissible for single conductor cables. Also since copper has about three thousand times the thermal conductivity of paper, the copper foil is highly effective in conducting heat out to the lead. The increased current carrying capacity for underground and aerial cables is shown in Fig. 3. The remarkable performance of the type H cable has led to its practically complete adoption for voltages 20 kv. and higher in this country and abroad. In fact it is in very general use down to and including generator voltages on the order of 11 kv. The type H construction is also used on the single conductor, high voltage cable, metalized paper being applied to the surface of the insulation as shown on the right in Fig. 2. The function of the metalized paper is to shield from all electrical stress any voids which may occur between insulation and lead.

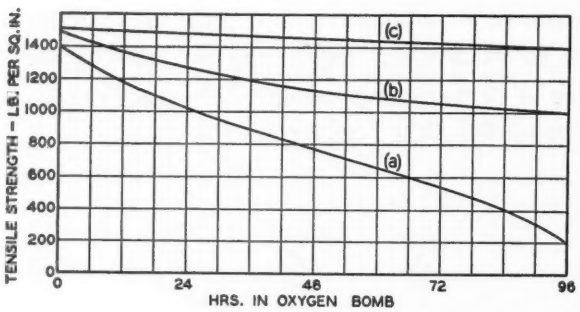


FIG. 1. AGING CHARACTERISTICS OF RUBBER COMPOUNDS AS SHOWN BY THE OXYGEN BOMB TEST PERFORMED AT 158 DEG. F. AND 300 LB. PRESSURE

(a) A compound containing 30 per cent rubber as shown by the chemical tests of the American Railway Association. (b) A compound containing 30 per cent rubber, but in which the percentage of rubber cannot be checked by chemical tests. (c) Compound same as (b) except that it has been specially compounded to meet high temperature conditions.

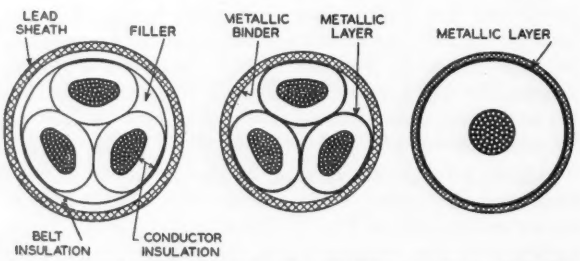


FIG. 2. CROSS-SECTIONS OF BELTED CABLE (LEFT), MULTI-CONDUCTOR TYPE H CABLE (MIDDLE) AND SINGLE CONDUCTOR TYPE H CABLE (RIGHT)

A. C. Resistance of Three-Conductor Cable

Due to the recent use of larger and larger sizes of conductor in three conductor cables up to 750,000 and even 1,000,000 cir. mils, it has become increasingly important to know accurately the effective a.c. resistance

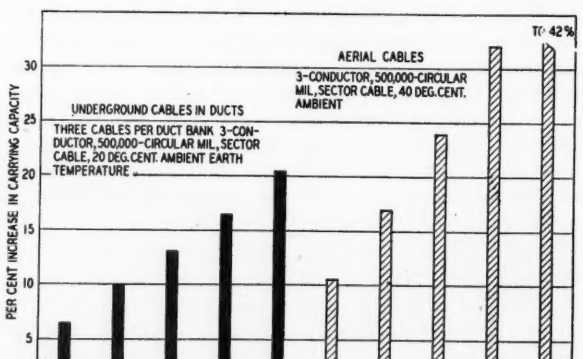


FIG. 3. INCREASE IN CARRYING CAPACITY OF TYPE H OVER BELTED CABLES

and reactance of such cables. These cables have additional losses due to skin effect, proximity effect, losses in the metallic binder tape, and in the lead sheath. The problem of these extra losses is important from the loss standpoint and from the standpoint of paralleling cables; it is being studied coöperatively by the Insulated Power Cable Engineers Association, some utilities, and the Electrical Testing Laboratories.

Materials

For many years, cable specifications required the use of manila rope paper, but in recent years wood pulp paper has been used almost universally in paper cables with a great increase in economy and partial increase in the dielectric strength. The use of super-calendered paper in place of ordinary wood pulp paper has also resulted in improved performance. Super-calendered paper has a higher specific inductive capacity and with its higher dielectric strength is the ideal material to place next to the conductor where the stress is highest. It thus becomes possible to grade the insulation so that the maximum stress near the conductor is materially

reduced. The improved stress distribution that may be secured is illustrated in Fig. 4.

The effect of using graded insulation, by which is meant the use of papers bearing different specific inductive capacities, is shown in Fig. 5. It will be seen that with super-calendered paper and high density paper there is an increase of 22 per cent in the over-all dielectric strength.

The breakdown strength of impregnated paper with its alternate layers separated by thin films of oil or compound is very much higher than the strength of either paper or a compound alone. In fact, the electrical strength of impregnated paper is very much higher than that of any other material available as cable insulation. In the early days, viscous compounds of rosin and rosin oil were ordinarily used but the insistent demand for lower dielectric losses led to the use of other compounds of the nature of petrolatum thinned with transformer oil. Mineral oils of the cylinder oil type, which can be mixed with rosin, have even lower losses than those obtained with the hundred per cent mineral compounds now available.

The effect of differences in impregnated compounds on the voltage time characteristics of cables is shown in Fig. 6. Curve X is for a compound containing no rosin or rosin oil, while curve Y is made on cable insulated with a special mineral oil-rosin oil compound. Note the slope of the curves as well as the fact that after 2 hr. application of voltage, they have about the same breakdown strength whereas for long-time tests there is a great gain for the one compound.

Oil Filled Cable

The greatest and most spectacular development of cables for many years has been the advent of the oil filled cable. An ordinary cable is impregnated with what might be called an oil but it is a fairly viscous oil which is not fluid at all operating temperatures, nor is the cable constructed to permit oil flow; consequently, due to the large coefficient of expansion of the oil when the cable is heated, the compound will expand radially and stretch the lead. When the compound contracts, the lead will not contract and partial vacuums or voids are created in the insulation. This phenomenon is the main enemy of cable insulation.

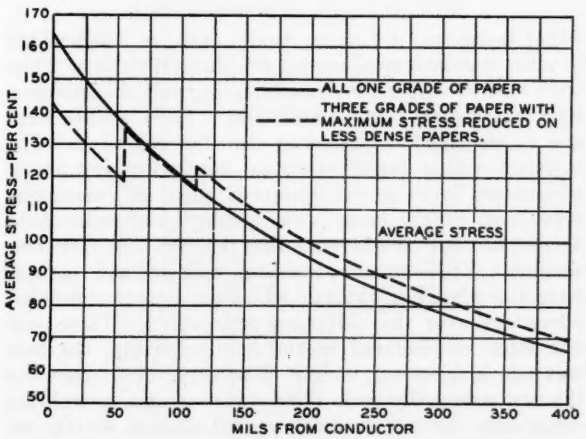

AVERAGE STRESS—PER CENT
MILS FROM CONDUCTOR
ALL ONE GRADE OF PAPER
THREE GRADES OF PAPER WITH MAXIMUM STRESS REDUCED ON LESS DENSE PAPERS.
AVERAGE STRESS

FIG. 4. EFFECT OF GRADING ON STRESS DISTRIBUTION WITH 4/0 ROUND CONDUCTORS AND 406 MIL PAPER

In an oil-filled cable, a thinner oil is used which is fluid at all operating temperatures and channels are provided for oil flow. When the cable is heated by load and the oil expands, the oil can flow lengthwise of the cable, through the channel or channels of the cable into the joints and out into reservoirs. When the cable cools and the oil contracts, it is forced back into the cable by pressure on the reservoirs and no voids are created. Cross sections are shown in Fig. 7 of a single conductor, 132-kv. oil-filled cable and a three-conductor, 33-kv. oil-filled cable.

Use of oil filled cables has permitted a considerable reduction in the insulation thickness of cables; in fact,

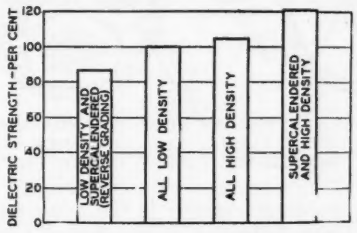


FIG. 5. EFFECT OF GRADING ON DIELECTRIC STRENGTH

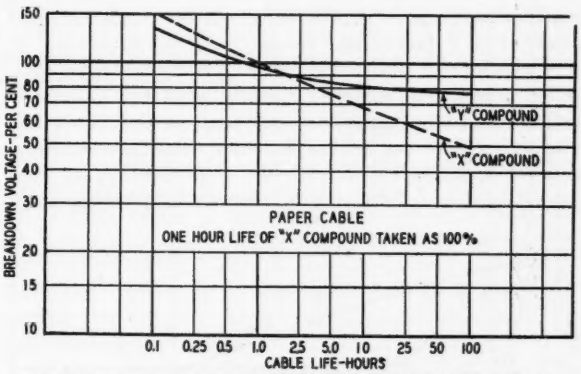


FIG. 6. EFFECT OF DIFFERENT IMPREGNATING COMPOUNDS ON CABLE VOLTAGE-TIME CHARACTERISTICS

the present 132-kv. oil-filled cables have slightly less insulation than has been used in this country for 66 kv. cables of the ordinary type. While at the present time there is no 220-kv. cable in service, there is no question about the possibility of manufacturing and operating such a cable when needed. The knowledge and experience gained on oil filled cable in service on field tests and in the laboratory have demonstrated that without doubt the 220-kv. cable can be made to operate with as high a factor of safety as the 132-kv. cable without exceeding dimensions that are entirely practical.

Carrying Capacity as Affected by Dielectric Loss

The curves in Fig. 8 are of interest and are self-explanatory. It will be seen that power factors which are obtained at the present time do not cause any serious loss in carrying capacity of cables in existing ranges of voltage. An examination of the curve for 330 kv., however, indicates that there will be some very difficult problems to solve in order to avoid undue reduction of carrying capacity due to dielectric loss when cables at this extreme voltage are required.

The road of a prophet is one of great difficulty and should be approached with caution. There are, however, some quite definite tendencies and trends apparent

in the cable industry which has already entered a rather revolutionary stage. An illustration of the remarkable improvements that have been made by the cable manufacturers hand in hand with the utilities is the fact that in a short period of about six years from 1921 to 1927, the maximum operating voltages of underground cables increased successively from 27 kv. to 33 kv., to 45 kv., to 66 kv., and up to 132 kv.

What made the last step possible and what makes

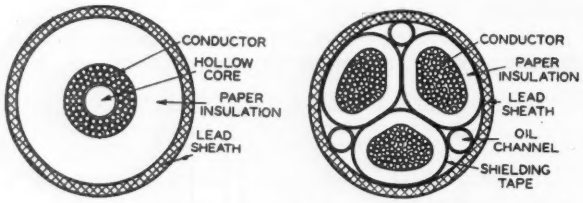


FIG. 7. CROSS-SECTION OF SINGLE-CONDUCTOR 132 KV. OIL FILLED CABLE (LEFT) AND OF THREE CONDUCTOR 33 KV. TYPE H OIL FILLED CABLE (RIGHT)

still further progress possible is the advent of the oil-filled cable idea. It should be emphasized that the oil filled cable has shown not only an ideal solution of all high voltage cable problems but it has demonstrated clearly the fundamental cause of early difficulties. It was well known that cable troubles from defective insulation, when they occurred, usually were due to deterioration caused by ionization and voids in the insulation. The writer does not believe, however, that there was any general appreciation of the fact that these voids were caused by the expansion and contraction phenomena of

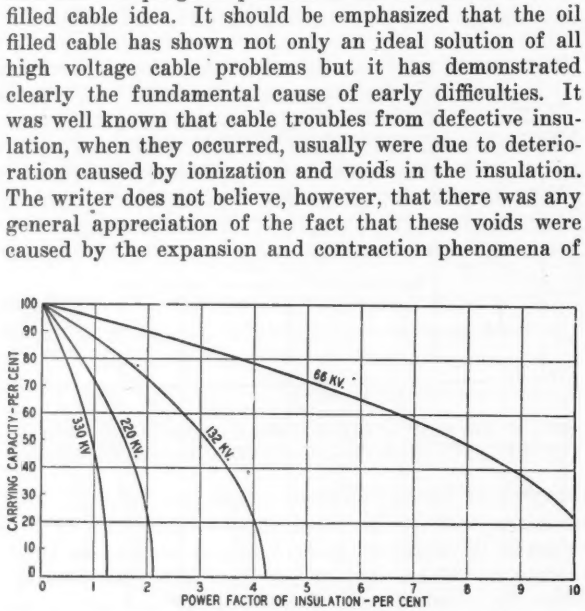


FIG. 8. CARRYING CAPACITY OF OIL FILLED CABLE AS AFFECTED BY DIELECTRIC LOSS. CAPACITY EXPRESSED IN PERCENTAGE OF MAXIMUM POSSIBLE

Curves are calculated on the basis of a 2,000,000 cir-mil single conductor cable with one circuit per duct bank.

the cable compound with load cycles. The oil-filled cable system is a complete cure to all these difficulties; however, now that the cause of the trouble has been thoroughly understood, cable engineers all over the world are searching for other solutions. If something could be placed in a cable which would expand and contract as the compound contracts and expands, void formation might be minimized. There is a multitude of new ideas on this subject, based on the fundamental idea that it is as illogical to make cables as they have been in the past as it would be to make a large bridge without an expansion joint.

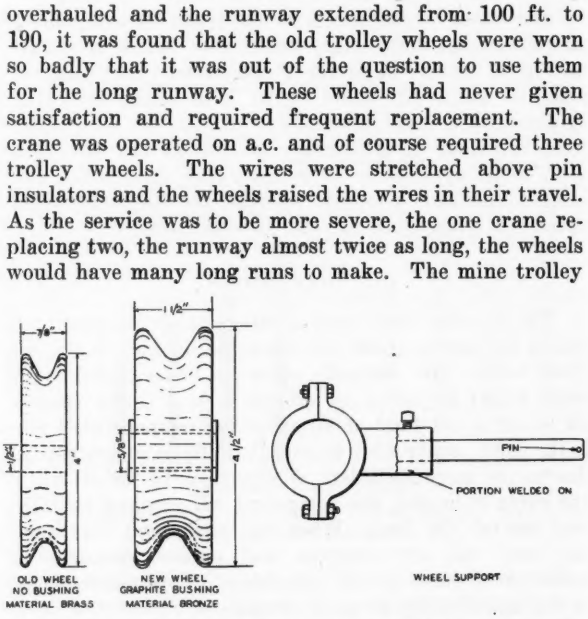
Out of these many ideas involving large scale research, some practical results will doubtless evolve. In the opinion of the writer, the real oil filled cable will continue to be the ideal form. This is said primarily because not only does the oil filled cable completely take care of expansion and contraction phenomena of oils but an oil filled cable has a degree of initial perfection that probably cannot be attained with any other form. Whether some of the special forms mentioned above will be economically justified in the middle-voltage range has yet to be proved.

Along with important developments in rubber and varnished cambric, undoubtedly the greatest future development will be in the increased economy with oil filled cables at present voltages due to the reductions in insulation thickness and in cost of accessories which would make possible its use at lower voltages. At the same time, we shall see oil-filled cables at higher and higher voltages.

Standard Wheels Improve Crane Trolley

By Grady H. Emerson

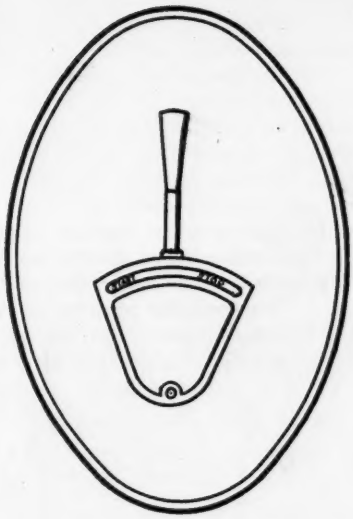
When the crane used in a stone plant was recently overhauled and the runway extended from 100 ft. to 190, it was found that the old trolley wheels were worn so badly that it was out of the question to use them for the long runway. These wheels had never given satisfaction and required frequent replacement. The crane was operated on a.c. and of course required three trolley wheels. The wires were stretched above pin insulators and the wheels raised the wires in their travel. As the service was to be more severe, the one crane replacing two, the runway almost twice as long, the wheels would have many long runs to make. The mine trolley



SHOWING CHANGES MADE IN CRANE TROLLEY WHEELS TO ELIMINATE ABNORMAL WEAR

wheel being well fitted for heavy duty, it was decided to place standard mine trolley wheels on the crane. They were bushed with a lubricated bearing and the axle surface was larger, being longer also. These wheels were also ½ in. larger in diameter than the old wheel. The material was a better electrical conductor and many advantages were to be obtained, such as purchasing from local supply house, new bushings and axles could be put in place at any time and the cost was very reasonable. The current collecting washers and springs were also placed on the axle which gave another decided advantage over the old plain type wheel. There was one hitch encountered in the holding clamp, the boss was not long enough to give a substantial support for the new axle and wheel. This was overcome by welding metal onto the end shown in shaded lines of sketch, the hole was then redrilled. The wheels are operating most satisfactorily since the change. The sketch shows details.

DIESEL ENGINE UPKEEP



PART XXII. ENGINE STARTING MEDIA AND SYSTEMS. MAINTENANCE AND VALVE TIMING. AIR TANKS AND STARTING PRESSURES. STARTING OBSERVANCES. OPERATION TESTS AND CHECKS

By EDWARD J. KUNZE

PROMPT and reliable starting is important to most Diesel power plants of the stationary type, with which we are mainly concerned; in the marine field, it is essential. With proper maintenance, reliability is assured. Starting systems for stationary engines usually are quite free from troubles but regular inspection and attention are necessary to insure reliability at all times. With few exceptions in which starting and stopping operations may be required frequently, such as in marine practice, the regular practice in Diesel power is to operate the engine as an air motor, using compressed air from storage tanks, until enough momentum has been established to compress the charge sufficiently to ignite the fuel oil when it is injected into the cylinder.

If electric current is available and an engine is driving a direct-connected, direct-current generator, the engine may be started using the generator as a motor

Another emergency method is to belt a small motor or gasoline engine to the flywheel, using a jack shaft if necessary, to turn the engine at about 25 r.p.m. The air tanks can then be pumped up as required.

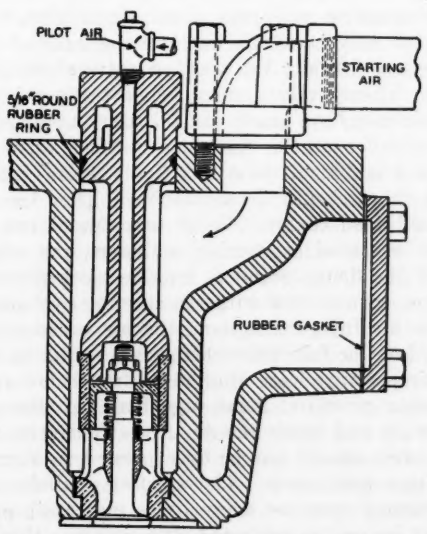


FIG. 1. STARTING AIR VALVE WHICH DEPENDS FOR ITS ACTION UPON THE TIMING OF A PILOT VALVE

If it is available, carbon dioxide may be used to charge a starting-air tank. Under no circumstances should oxygen, hydrogen or other gases which are liable to form explosive mixtures when mixed with air, oil or another gas be used for filling air tanks. Fatal accidents have attended such use.

STARTING AIR SYSTEMS

Use of low pressure air for starting and a bypass arrangement from the spray air bottle in an air-injection system makes it unnecessary to install a stand-by air compressor unit. Where solid injection of fuel is employed it is advisable to install an auxiliary unit. For large plants it is convenient to have duplicate auxiliary units, one driven by a gasoline engine, the other electrically driven.

There are two distinct methods of air starting and the air starting valve is operated either mechanically by means of cams and levers or pneumatically by which air is admitted behind a piston in the air-starting valve mechanism.

The former type employs a valve in the cylinder head which acts as a check or non-return valve. A secondary cam-operated valve located at the cam shaft admits the high pressure air under the check valve, opening it against a coil spring-pressure. Compressed air, automatically controlled, is brought at full pressure to the engine cylinder where a hand operated lever, when lifted, admits the air to the cylinder through the mechanically operated air distribution valves on the control box. Air thus distributed to the several cylinders enters them through the check valves in the cylin-

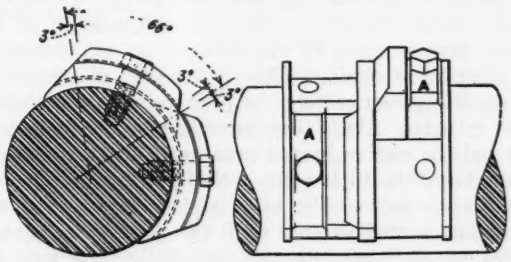


FIG. 2. STARTING CAMS PERMIT OF TIMING ADJUSTMENT

der heads as long as the hand lever is held up. When it is dropped, no more air can reach the distributing valve and springs lift them off their seats.

In the pneumatic air starting system, the starting valves are opened by the pressure of air acting on a piston to which the valve and stem are attached. The method of admitting the actuating air at the proper time is by a distributor. Such a valve whose functioning depends upon the proper timing of pilot air, which acts upon the starting valve, is shown in Fig. 1.

In another valve of this variety when starting air is admitted at the lower part of the valve, passages in the stem permit the pressure to reach the underside of the attached piston, thus forcing it to the top of its cylinder and bringing the valve roller against its cam,

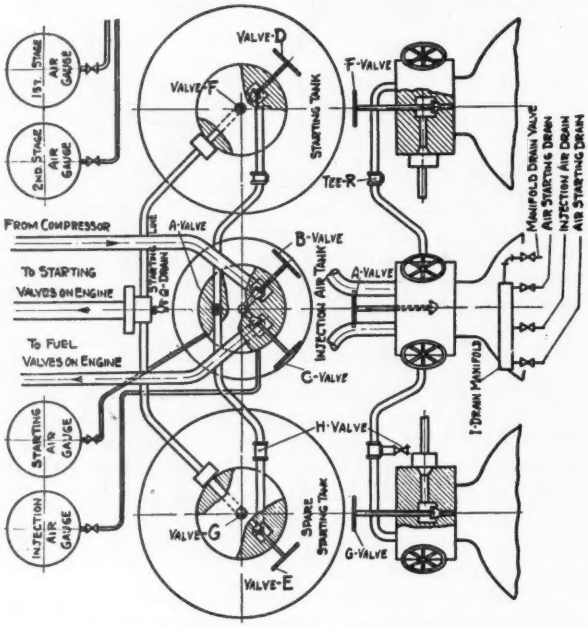


FIG. 3. AIR TANK ARRANGEMENT WHERE FUEL INJECTION BY AIR IS EMPLOYED

causing any downward movement of the lever to force the spindle downward against pressure spring.

Leaky starting valves are dangerous because they are likely to become sticky and result in a serious breakdown. If the valve should remain open until the beginning of the compression stroke and then close, the compression will then start with a pressure much above atmospheric pressure, consequently, at the end of the stroke, it will reach an excessively high pressure which may buckle the connecting rod.

Timing Starting Valves

Timing of the starting valve as given by the builder of the engine should be followed. Adjustment of the setting may be made by the operator by adjustment of the pilot valve timing. This is done by disconnecting the small pipe connecting the pilot valve to the starter-valve cylinder. Air is then turned on to the pilot-valve line and the engine barred over until air starts to discharge from the little pipe. This indicates the opening of the pilot valve. The pipe is then reconnected and the engine barred further until the pilot valve exhaust begins to discharge through the little hole into the atmosphere. This indicates the closing of the pilot valve.

Because of the necessary lap of the slide valve, the movements of the pilot valve stem, particularly the beginning of movement and the seating, do not necessarily indicate the actual starting-valve timing. As the illustration Fig. 2 is of a marine-engine starting cam, both ahead and astern cams are shown. Stationary engines have a single cam which may be adjusted by loosening the clamp segment A and moving the cam.

Timing of the starting valve, of the pneumatically operated type, is not actually indicated by the setting because there is a lag in both opening and closing due to the capacity of the piping between the pilot valve and the starter-valve air cylinder and to the capacity of the air cylinder itself. The actual action of the valve is best shown by use of an indicator applied to the air cylinder of the starting valve itself.

Air Tanks

Air tank capacity varies greatly with engines of different makes. In any case the capacity should be at least 10 times the piston displacement of one engine cylinder. The tanks should be placed close to the engine with their valves convenient to the control position of the operator. A convenient air tank arrangement for air injection systems is shown in Fig. 3.

Due to the change in vapor pressure of air when it is compressed, considerable moisture is deposited in air tanks. This should be drained off at regular intervals to prevent corrosion and loss of capacity due to displacement of air by accumulated water. Not more than one quart of water should be allowed to accumulate. If the moisture reaches the fuel valves, the engine may pound due to the delay of ignition caused by the spray. The fastening of the tube in the air tank head should be examined from time to time.

During the annual overhauling the air tanks and cooling coils should be steamed out, if steam is available. If not, a few pailfuls of scalding hot lye water should be poured into the upper ends of the coils and drawn off at the drains. After this treatment, the ports should be rinsed thoroughly with fresh water.

Starting Air Pressures

High starting pressures cause the engine to start quickly but may be severe on the valve gear of a four-cycle engine. Usually the starting valve closes just before the exhaust valves open, hence the first cylinder to take air may have nearly the full starting air pressure in the cylinder at the time the starting valve closes.

Since it is difficult to start a badly worn engine, the starting valve should be set to open after the piston has passed dead center. Where only one or two of the cylinders are used as starting cylinders, the admission valves of the firing cylinders may be blocked open and the engine turned over with the starting cylinders.

In an air injection system, the air pressure should be turned on the fuel valves before the engine is started. If the air pressure were allowed to drop below cylinder compression pressure, flame may back up through the atomizer tip and ignite the oil in the fuel valve casing.

Cylinders should not be over primed in starting or pre-ignition may occur. The starting cylinder should not be turned over too many times under air pressure or it may become so saturated with moisture that it will not fire when the fuel is turned on.

Pipe Treating and Fabrication

By J. B. Nealey

DEMAND FOR increasing operating pressures and temperatures has led to pipe, made from special alloy steel and heat treated in order to obtain the required strength without resorting to a heavier section. The heat treatment also assures the maintenance of physical properties at elevated working temperatures.

This procedure is being used by the Pittsburgh Piping & Equipment Co. which has also made a further development, a combination bend and expansion joint produced by putting creases in the pipe on the inner radius of the bends which act as expansion members while in use. This preserves the original metal thickness in the outer wall of the bend, giving an additional factor of safety and added flexibility.

In the fabricating plant of this company, a central building is given over to pipe fabrication, with pipe cutting and threading machines, bolt threading machines, engine lathes and Van Stoning machines located along the east side while welding, testing and refacing equipment is located along the west side, leaving the main bay, Fig. 1, open for handling and fabrication. On the north side, a building 100 by 200 ft. serves for pipe bending; a building on the south side serves as a shipping department with space for the collection of material on individual orders prior to shipment; a building of three bays on the east side serves as a machine shop.

In the testing department are two pumps, one for high and the other for low pressure; with an intensifier designed so that test pressures 20 times the pressure impressed on the low-pressure side, a maximum of 30,000 lb. per sq. in. is obtained. Seven water pipe lines, arranged along one wall with pump, accumulator, heater and service connections give tank water, city water, hot water, 500, 750, 1000 and 1500 lb. available by manipulating a valve.

Van-Stone Operation

For upsetting or Van-Stoning of pipe ends, the flanges are bored slightly larger than the outside diameter of the pipe and slipped on before the end is fabricated. The pipe end is then heated, upset and flanged out at right angles to the pipe axis, the flanged ends being completely machined in engine lathes so that when the flanges of two sections are bolted together with a gasket a tight joint is assured. All sizes of pipe, from the smallest up to 36 in. diam. are processed in this manner.

Each Van-Stone unit consists of a gas heating furnace and a hydraulic machine with dies, Fig. 2, with a jib crane and hoist to handle the work. The heating furnace consists of two circular steel plates bolted together over a cylindrical steel plate shell and lined with refractory and insulating materials, these furnaces ranging in size from 18 in. diam by 6 in. deep to 5 ft. diam. by 18 in. deep. Each is heated by two gas burners, one on each side firing tangentially to the inner radius of the refractory material. Gas and air are premixed in the proper ratio for complete combustion, a stream of pressure air entraining the gas. Temperature control is aided by the use of radiation pyrometers, with indicators and the proper temperature for each individual requirement is maintained.

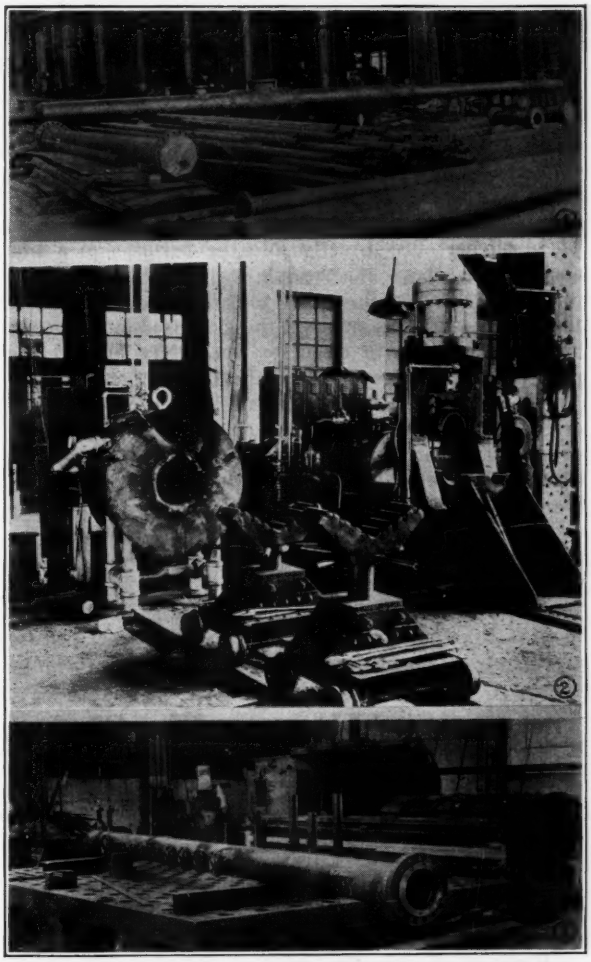


FIG. 1. PIPE FABRICATING DEPARTMENT
FIG. 2. VAN-STONE HEATING FURNACE AND FLANGE-FORMING MACHINE
FIG. 3. PIPE BENDING FURNACE AND BENDING TABLE

In front of each furnace and Van-Stone machine is a track on which operate pipe stands on trucks, adjustable as to height. Pipe up to 40 ft. in length can be handled in any machine. The pipe is transferred from heating furnace to machine by the jib crane, the heated end being thrust into position and clamped in place in the machine. Each machine includes two different power applications, the first consisting of hydraulic cylinders for forward thrust of the head carrying the forming members, for pull-back of this head and for clamping the pipe in position; the second is a motor drive for the forming members, which consist of rotating rollers set on revolving heads at various angles. When normalizing is required on these formed ends, the same heating furnaces are utilized.

Pipe Bends

In the bending department, located so that exceptionally long pipe can be handled easily, the heating furnaces of brick construction, Fig. 3, range in length from 4 to 15 ft. In cross section these furnaces are about 4 ft. high and 5 or 6 ft. wide. The top of each is built in sections, each consisting of a cast steel clamp holding an arc of refractory of the same length as the furnace width. A series of these form the roof of the furnace,

more sections being added when it is necessary to lengthen the furnace. These clamps are hinged on the top plates of the burner side of the furnace and are simply lifted up when the furnace is to be charged or discharged.

Heat is supplied to a 15-ft. furnace through 10 gas burners firing from one side, a motor-driven blower furnishing to each pair of burners air and entrained gas in the correct proportion for complete combustion. These burners fire directly into the furnace on a line about 6 in. above the hearth, cast-iron blocks being placed on the hearth so that the pipe rests just above the flames. In this manner the hot products of combustion are made to circulate completely around the pipe which assures evenness of heating.

The pipe is first filled with sand, which preserves the original cross-section when bending, brought up to the proper temperature in the furnace, then transferred to the bending table by means of an overhead traveling crane working in conjunction with the jib crane. One end of the pipe is clamped on the bending table and the other end is pulled around by a motor-driven capstan to form the radius desired.

While bending, cold water is played on the hot pipe to set it, the water acting as a quench. A distinct feature of this operation is the fact that the sand in the pipe performs a dual function when the proper care is exercised, maintaining the original cross-section and heat treating. While the pipe is cooled by quenching, the sand retains most of its heat, giving it up to the cooler pipe, which is thus tempered or drawn. In other words, during bending the pipe is given the regular hardening heat treatment by quenching from a temperature above the critical range, which leaves it in a state too hard for practical use. It is then reheated to a lower temperature, which draws it back to the proper degree of hardness. Skill and judgment are required to obtain the properties desired as the heat retention capacity of the sand must be balanced with the proper volume of water.

Creased bends, which permit bending pipe on very short radii for expansion purposes and to save space are made differently. Heating is by specially designed portable gas burners lined with refractory material, the proper mixture of gas and air being supplied to the burners through one or two venturi tubes, depending upon the pipe size. The pipe is first filled with sand, then placed on the table with one end clamped, the burner put in position and, when the proper bending temperature is reached, the bend is pulled by a specially-designed, motor-driven capstan to the desired angle and radius.

Where To Take Draft Readings

PROPER LOCATION OF DRAFT TUBE IN FURNACE DEPENDS UPON DESIGN AND OPERATING CONDITIONS. BY LEWIS M. ELLISON

UPON INSTALLING draft gages to obtain improved damper regulation, the following recommendations will be helpful in locating the points at which draft readings should be taken.

Furnace or over fire draft is essential with practically all types of boilers and methods of firing. It is best to take this reading through the side wall of the boiler setting about midway between the front and bridgewalls and well up in the furnace chamber. The sketches Fig. 1 show recommended locations for typical installations. Where side wall location is impractical due to battery settings or other local conditions, insert draft tube through front wall well above the grate or burner and about midway between the side walls. Fig. 1C shows an example of front wall location.

In firebox type boilers the over fire draft is usually omitted and damper regulation obtained from the uptake draft. It is inadvisable to penetrate through side or front walls of the boiler because of the water-leg construction unless provision is made by the boiler manufacturer or by a competent welder in the field for a suitable thimble located as recommended above for insertion of the draft tube.

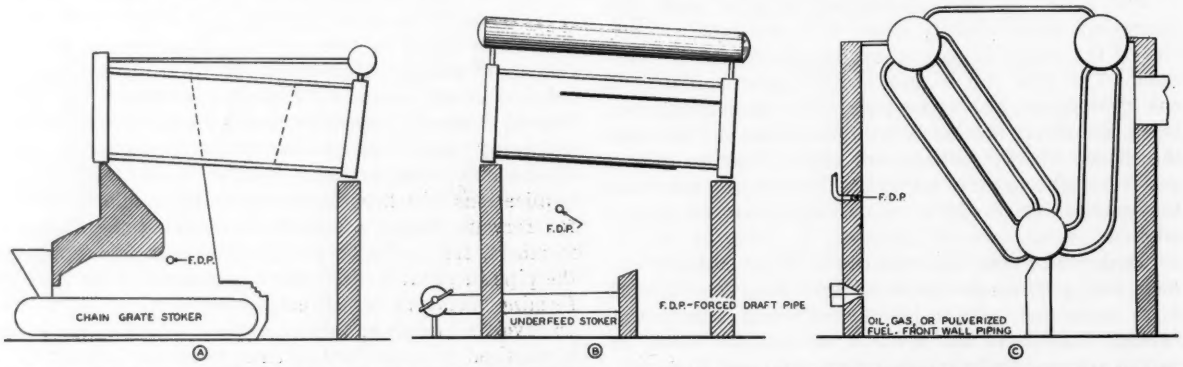


FIG. 1. PROPER LOCATION OF DRAFT CONNECTIONS ON (A) CHAIN GRATE STOKERS (B) UNDERFEED STOKERS AND (C) FRONT WALL CONNECTIONS FOR GAS, OIL OR PULVERIZED COAL FIRED FURNACE

On forced draft installations, it is necessary to know the under fire draft in the ash pit or stoker windbox (known as the windbox or pit pressure) in order intelligently to control the amount of air being supplied to the furnace either by regulation of the fan speed or of the damper in the duct between the fan and the windbox or by both means. With underfeed and certain types of overfeed stokers the draft tube is usually in-

*Ellison Draft Gage Co., Chicago, Ill.

serted through the front wall of setting or the iron work of the stoker, actually projecting in either case 6 or 8 in. into the windbox under the retort or grate as shown by Fig. 2.

In some installations it will be more convenient to obtain this reading through the side wall, in which event make certain that the draft tube extends 6 or 8 in. into the main windbox instead of terminating in an ashpit section under side or rear ash dump grates. With forced draft chain grate stokers the readings will of necessity be taken through the side wall. The draft tube should project into each windbox zone about 12 to 18 in. On very wide stokers of this type it is sometimes

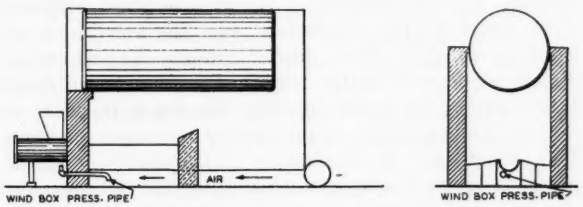


FIG. 2. PIPING FOR SIDE DUMP UNDERFEED STOKER AND H. R. T. BOILER

advisable to take these readings from both sides and it is essential to do so when air is taken from ducts on both sides of the stoker.

In all cases, locate the draft tube in the windbox so that the tube opening is preferably perpendicular to the direction of flow of the air, using an elbow on the end of the pipe if necessary to obtain this condition for true static readings. Tube opening should never face the flow as the impact pressure would then be indicated.

It is of further advantage to obtain the uptake draft, sometimes known as last pass or boiler outlet draft, especially on water tube boilers. The draft tube should be inserted through the side wall of the setting or breeching connection so that tube extends about ¼ across the passage in the last pass or flue. It should be below and clear of the damper blades so as to read the draft on the boiler side of the damper. On tubular, firebox and Scotch marine boilers the draft tube should be inserted from the side and extend about ¼ across the passage in the smoke box connection, well above the top row of flues so as not to interfere with soot blowing but below and clear of the damper.

Pipe lines to the gage should be ¼-in. iron pipe or 5/16-in. OD 20 B. & S. copper tubing. To prevent possible entrapment of condensation in cold weather and in cold boiler rooms, the piping should slope down towards the gage or down towards the point at which the draft is taken. Pipe for furnace draft through side or front walls of the boiler should be ¾ or 1-in. iron pipe, extending only part way through the wall to prevent burning off. They should be fitted with a tee on the outside end, fitted with a plug for cleaning in the end and the connection to the gage extending up from the top of the tee as shown by Fig. 3A. On air-cooled walls, insert pipe beyond air spaces. Close in space around pipe with mortar—past air spaces.

For other readings such as pit pressure and uptake draft, use ¼-in. iron pipe fitted on the outside end with a tee and plug for cleaning. To guard against soot stoppage, the side outlet of all tees, connecting with pipe lines, must point up. The pipe openings in all draft passages should point either with or at right angles to the flow of gases, but never against the flow.

Where excessive pipe line stoppage may be encountered as in pulverized fuel installations, it is advisable to provide alundum or other porous material filters in the pipe lines. To prevent possible erosion of the filter and reduction of pipe areas, it should be screwed into dead end or pipe line by using a 1-in. coupling and nipple as shown in Figs 3B and C.

Length of pipe line from draft tube to instrument need not be considered in the location of the gage. Visibility from the damper controls is of prime importance

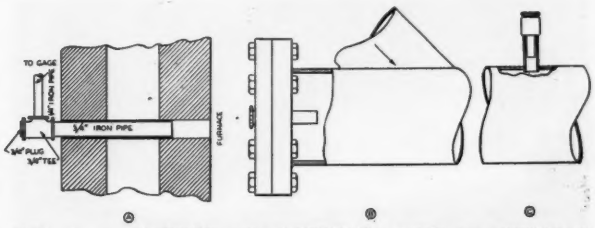
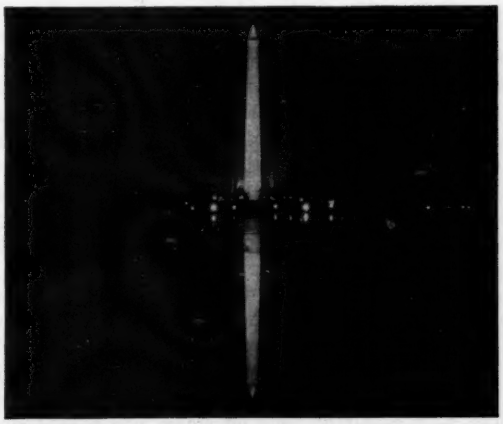


FIG. 3. A. METHOD OF INSERTING PIPE IN FURNACE WALL. B. AND C. METHOD OF INSTALLING FILTER

to obtain the most effective and efficient regulation. Quoting from a recent report on experiments made by the author: "Piping Drop: —— Experiments made on a 500-ft. line of ¼-in. bore copper tubing ———. A pressure of minus 1 in. was then established ———. The lag was 10 sec. when the two gages checked exactly. When pressure was released, the liquid in the long line (500 ft.) receded to zero in 20 sec. the gages again checking ———".

Lighting the Washington Monument

NO LONGER A NIGHT-TIME menace to low flying aircraft, the Washington Monument is now illuminated to warn aviators and to display the splendor of the 555-ft. obelisk. The lighting is effected by four banks of five



Westinghouse projectors illuminating the faces of the shaft, complemented by two searchlights distantly located floodlighting the top. The entire shaft is lighted each night until 11:45 p. m. Then, till daybreak, two searchlights illuminating the top and four obstruction markers in the four observation windows serve as a warning to aviators.

Readers' Conference

Pressure Drop Across Steam Purifier

ON READING H. M. Spring's comments on the pressure drop across steam purifiers, published in the March 1 issue, one might receive the impression that the pressure drop Mr. Spring discusses is common to all types of steam purifiers. The value of the information would have been enhanced if the specific type of

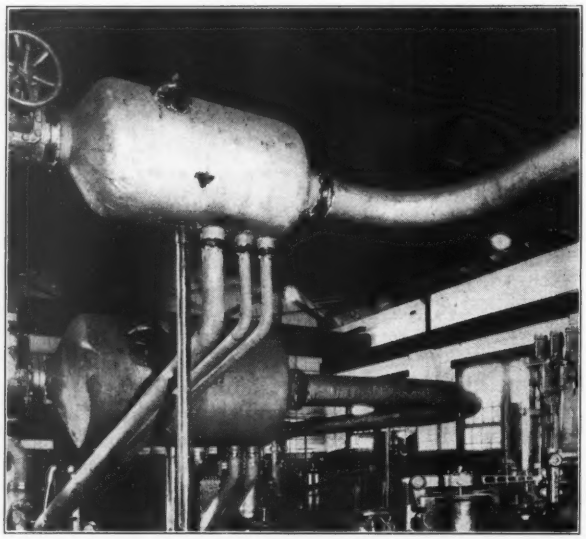


FIG. 1. TYPE OF STEAM PURIFIER TO WHICH DATA GIVEN HERE REFER

purifier were mentioned for, with the statement so made, engineers are apt to believe that the pressure drop he experienced is common to all types of steam purifiers irrespective of their design or manufacture.

In order to give pertinent information on this point, the writer has observed during the last 5 yr. the operation of Cochrane steam purifiers with particular reference to their efficiency and moisture removal, as well as the pressure drop experienced under different pressure and steam conditions. With the installation of hundreds of these units, there is yet to be one case where the dirt accumulated on the separating elements, causing either a high pressure drop or interference with the efficiency of the apparatus. The type of steam purifier about which the writer is discussing is illustrated by the Fig. 1. It is an apparatus designed on the basis of low velocities, simple baffling, these baffles being of the self-cleaning type such that possibility of accumulation of dirt is very remote. As a specific illustration, the following table gives the pressure drops that have been experienced as a result of tests on steam purifiers designed for 150 lb. service.

Capacity, Per Cent	Pressure Drop, lb. per sq. in.
100	0.90
75	0.50
50	0.27
25	0.10
0	0.0

These pressure drops were determined as a result of actual tests and field experience, indicating that, even after years of operation, the pressure drop remains constant. This is further verified and checked by the fact that an inspection of steam purifier units has shown no evidence of accumulating dirt or interference when purifying steam from a boiler having relatively high concentration of suspended matter. As an illustration, Fig. 2 pictures a severe condition imposed upon steam purifier operation from the standpoint of handling the dirt. The samples indicate the amount of dirt or suspended matter contained in the concentrated boiler water, the steam entering the steam purifier, as well as the condensed steam leaving the steam purifier. This is not only an illustration of the efficiency of the device from the standpoint of handling dirt but from the standpoint of producing pure steam as well.

One installation has been in operation for a period of over 4 yr. and has never indicated higher pressure drop than when originally installed nor has it ever required cleaning because of the accumulation of dirt. It is

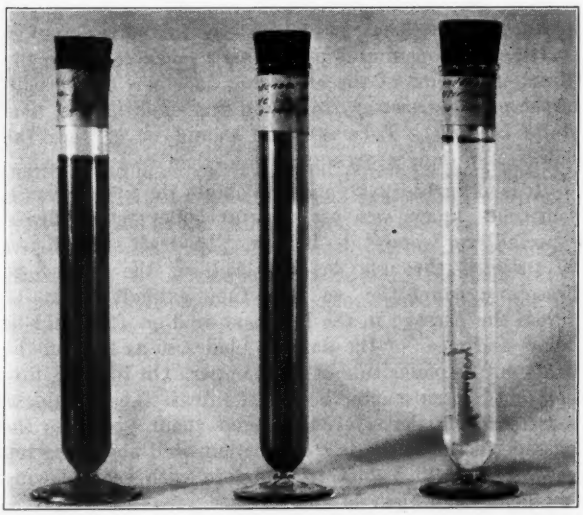


FIG. 2. LEFT TO RIGHT: SAMPLE OF BOILER WATER, CONDENSATE OF STEAM ENTERING PURIFIER, CONDENSATE OF STEAM LEAVING PURIFIER

therefore, important in interpreting pressure drop across steam purifiers, to state specifically the type of purifier with which the experience is connected, otherwise improper and unfair conclusions are apt to result. Philadelphia, Pa. C. E. JOOS, COCHRANE CORPORATION.

Preventive Service vs. First Aid

"IN ANOTHER half hour, the wornout lacing of the governor belt broke," writes D. J. Altizer in his article on "Corliss Governor Supports Were Hazardous," published on page 273 of the March 15 issue. This statement indicated that the plant in which the device described was used, was operated on the old-time principle of operating a part until it broke.

Belt laces should be treated much as shoe laces are

treated by those who are wise. Instead of permitting the shoe lace to break, causing perhaps an "embarrassing moment," wise men renew them when they appear to thin out in any one spot, thus avoiding the necessity of putting a knot in the lace and retying it at a time when it is desired to lose not even a moment's time or when it would be inconvenient or uncomfortable to do so.

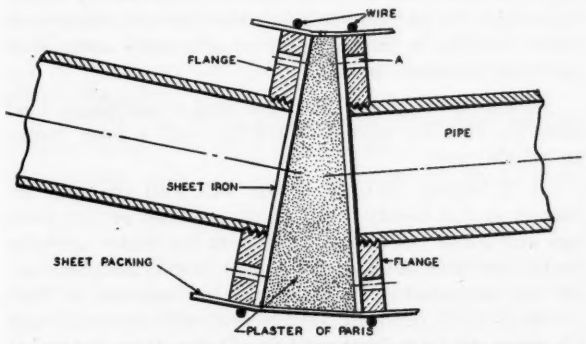
Belt laces do not break without warning; it may be said that they take a long time to break. Replacing a belt lace when it shows signs of wear may be done easily between regular shutdowns of the engine. Forced shutdowns during a manufacturing period are costly not only due to loss of productive time of the machinery of the plant but of the employes of the plant. The heading of the first article in the Readers' Conference section of that same issue "What Price Neglect" applies here.

Preventive service in operation is decidedly of greater worth than first aid or corrective service and it should be applied to all branches of power plant operation. It is an insurance against destructive accident as well as against disruption of organization and loss of production caused by forced shutdowns.

Wheaton, Ill. EDWARD J. KUNZE.

Plaster of Paris Model for Dutchman

IN THE Feb. 15 issue on page 182 I note Mr. Fischer's comments about dutchmen. As a rule, it is not unusually difficult to get measurements and have the dutchman made, but twice within the past year I have had occasion to use another method even though the extensive use of welded pipe is reducing the usefulness of dutchmen. This method I speak of makes use of a plaster of paris model as shown by the sketch. Two sheet-iron circles are cut the same size as the flanges and stuck on as shown with a bit of shellac. A piece of sheet packing is then wrapped tightly around both flanges and held in place by a couple of wraps of wire as shown. Plaster of paris is then poured in through a hole in the top and puddled around a little to be sure



METHOD OF MAKING PLASTER MODEL OF DUTCHMAN

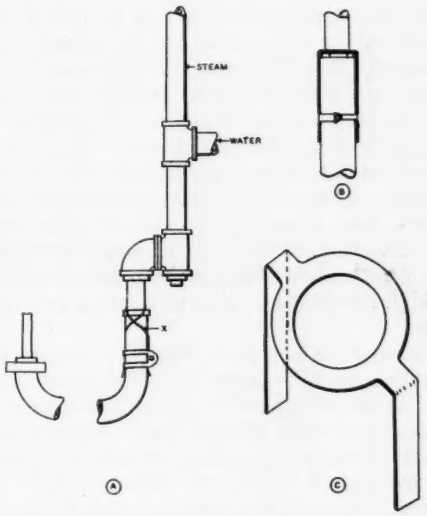
all corners are filled. The plaster soon hardens after which the packing can be removed and the plaster and flanges marked before the model is shipped out. A little oil on the sheet iron keeps the plaster from sticking. The bolt holes can then be marked with a pencil and the model used for making the dutchman. If sheet iron the thickness of the gasket is used, no allowance need be made from the model dimensions, otherwise an allowance must be made.

Do not make the mistake that we did the first time we used this method. We used sheet packing instead of sheet iron and the plaster bulged out into the pipe so that we had to remove the model with a hammer and chisel. Of course, the dutchman in the sketch is exaggerated. As a rule, I do not approve of them, although they must be used occasionally. Sometimes it is well to ream out the holes at points marked A so that the bolts will go through better. There is, of course, a tendency to bend the bolts and I have in the past used a shallow countersink to give the heads and nuts a firm seat. Ring dutchmen should be discouraged as there is a tendency to break the flange. I've seen two of them broken.

Springfield, O. F. PAUL.

Safeguard for Steam Hose Connection

THIS DEVICE for securing of steam hose by no means suggests that other than regulation steam hose clamps should be used. Rather, it aims to protect steam engineers whose requisitions for such necessities have been repeatedly refused.



DETAILS OF GUARDS FOR STEAM HOSE CONNECTION

That the method of wiring steam hose on the hot water syphon as shown at A is by no means foolproof was brought home to the writer when the hose blew off, injecting live steam down the overalls of a mechanic who suffered a terrible scalding. But a few days later, the same connection blew off into a $3000 machine and wrecked it. Steam hose connections were then purchased.

If the purchasing agent will not let you have the proper connections, then the next best device would be perhaps that shown at B. The guard, C, is cut out of No. 10 gage galvanized iron. The ring comes down on the rim of the hose connection nut, the ends are bent down and firmly secured by the hose clamp.

The writer has narrowly missed the hospital by defective steam hose tube blowers and perhaps feels strongly on the subject but we really believe that inspection of steam hose connections should be a governmental duty.

Vancouver, B. C. S. H. COOKE.

Plant Operation Problems

Motor Operation Problems

IN THE FEBRUARY 15 issue of Power Plant Engineering on page 183 there are listed a number of questions relating to motor operation problems. I am submitting answers to these as follows:

1. In case a wound-rotor motor whose collector rings have been removed and rotor terminals securely tied together fails occasionally to start when proper voltage is applied to the terminals, what is the cause and what is the remedy?

A. Wound rotor motors are so constructed that a resistance is necessary to produce satisfactory results in starting. They are designed for this class of duty; however, most of these motors will operate with rings short-circuited. Sometimes it is necessary to use a compensator for starting. When one is found that has "dead points" or fails to start when voltage is applied, it is generally due to the fact that the resistance is too low. When an induction motor has the same number of slots in the stator as the rotor there is often a cogging tendency or locking effect which would result in slots in stator and rotor locking opposite each other at starting. Shallow rotor slots, and few slots per pole will also have this effect. Low resistance in squirrel cage also tends toward this effect. End rings of magnetic material in squirrel cage motors that has been experimented with give a high resistant end ring at starting and low when running.

If the drive is a belt, it would be easy to give the belt a pull in the above case; this would cause the motor to start. If this is impossible, a heavy resistor may have to be inserted in series with at least two legs of the rotor. The resistor should have enough current carrying capacity so that it will have little influence after starting. Worn bearings may cause the above effect also. In ten years, I have found only two cases of this kind. Each of these motors was old style. One was 15-hp. and the other 75-hp.; both were 220-v. The 15-hp. had the rings removed and the 75-hp. had the brushholders short-circuited. A short circuit in the rotor winding near beginning of phase might lower resistance enough to prevent starting. I believe that the place may be marked on the rotor so that a slight turning of the rotor from this point will cause it to start.

A more satisfactory way would be to replace rings and use a double throw switch. Throwing the switch one way would insert resistance in at least two legs of rotor. When the motor attained speed, the switch would be thrown to short-circuited side quickly.

2. What loss in efficiency would result from connecting 220-v., 2-phase motors of 2 to 20-hp. for 220-v., 3-phase?

A. This is both a change in phase and is equivalent to a change in voltage, because of the fact that a two phase motor has approximately 25 per cent more turns in series in its winding than a 3-phase motor of the like design.

There are three different ways in which a change from 2 to 3-phase may be accomplished but none of the three is ideal and for permanent operation it will pay to rewind completely for three-phase operation. These methods are listed in order of their quality. Cut out 20 per cent of 2-phase coils and operate on 3-phase connection. Use all 2-phase coils and reconnect for 3-phase diagram. Scott connection, better known as the "Tee" connection. As the current for a 3-phase motor is about 115 per cent of the 2-phase motor, for the same heating the horsepower on 3-phase will be about 87 per cent of what it was on 2-phase. The starting and running torques will be only about 90 per cent what they were on 2-phase. The efficiency will be about 2 per cent lower, the power factor approximately 5 per cent lower, starting torque 38 per cent lower. Temperature from 8 to 15 per cent higher.

In using a Scott connection, it is best to reconnect with a top to bottom connection as this connection gives a better distribution of wattless current found in this class of connection.

3. In a 3-phase motor, line voltage is balanced but currents are not in the three phases. Resistance tests at 20 deg. C. show: For phase 1—2, 0.82 ohm; for 2—3, 1.24 ohm; for 3—1, 1.24 ohm. Where is the trouble?

A. It is evident that the phases with the identical reading are correct. This would of course indicate the phase 1—2 as being defective. As the reading is smaller, the indication is that there is a short circuit or ground on this phase. The connection used would indicate at about what point this short or ground might be found. I take it for granted that this phase would have a higher current than the other two. The resistance of this phase is only about ⅔ the others. This would indicate a short between jumpers in the same phase. A hot coil may have burned through the insulation of another coil in the same phase but different group. Occasionally shorts occur between end connections where the coils cross each other but this is unusual and when it does occur it is generally between phases.

4. For average load, 5.5 hp. and a maximum load over 1½ to 2 hr. period of 6.8 hp., will a 5-hp. motor be satisfactory?

A. I believe that the motor will pull the load although it is a steady 10 per cent overload on the average and when the 6.8-hp. load is on the motor operates at 135 per cent load. If the motor is well designed and of late manufacture it is capable of standing a 2-hr. overload of 25 per cent but the heat will rise to 55 deg. C. above ambient temperature. If the temperature of the room in which the motor operates is not such that the motor will reach 85 deg. C. the chances are that the motor will operate satisfactorily; however, it will not be economical because of the shortened life of insulation of windings, due to the continual overheating. At no time during the motor's operation does it have time to reach normal temperature. The efficiency of the drive will be high, if possible to use under these conditions. I would recommend a 7½-hp. motor for this drive because the low load is not sufficient to reduce the efficiency

and the high load leaves ample reserve and a motor this size would not give an overmotored drive, whereas the drive with a 5-hp. motor is undermotored.

If the motor is rated 5-hp. at 55 deg. C., it will not be advisable to use on the above drive at all.

5. Load on a 20-hp. slipring motor with speed varied, runs from 5-hp. at high speed to 25-hp. at low speed. At heavy load, the speed is too irregular. Can this be remedied by a different controller?

A. At high speed, the motor runs with no resistance in series with the rotor windings. The speed of an induction motor is practically constant. The wound rotor motor with all resistance cut-out operates as an induction or squirrel cage motor. It so happens at the light load the speed is high and at the heavy load the speed is below synchronism. Below synchronism or rather when resistance is in series with the rotor the speed is not stable and varies with the load. The load happens to be 125 per cent and there are probably variations of this load. It may be that there are also variations in the voltage. An improvement in operation may be secured by paralleling the resistors used to secure the speed but this may require additional grids. I am under the impression that the resistance used is too great. In other words the grids used have too small scross-section. I do not see the advantage of a new controller. The characteristics of the motor would determine its ability to pull the load steadily. If it is possible, check load to see whether it cannot be stabilized and made more even.

6. For individual drive on isolated machines, what is the best type of induction motor for variable speed?

A. The high-slip wound-rotor motor is the simplest type of induction motor which may be used for variable speed drive of isolated machines. Machine tools are generally the class of isolated machinery requiring variable speeds. The slip ring motor with proper control will give a constant speed for constant torque load. This class load is common to machine tool work. The next best motor would be the pole changing method. These motors usually have two stator windings and two speeds to each winding. These in combination with flexible gear box will give most any speed required. The speed is constant at all loads within the hp. of the particular windings. There are a large number of leads brought out of the motor and trouble in one winding directly affects the other.

I believe that the slip ring motor is the best for this purpose considered from every angle.

Birmingham, Ala. GRADY H. EMERSON.

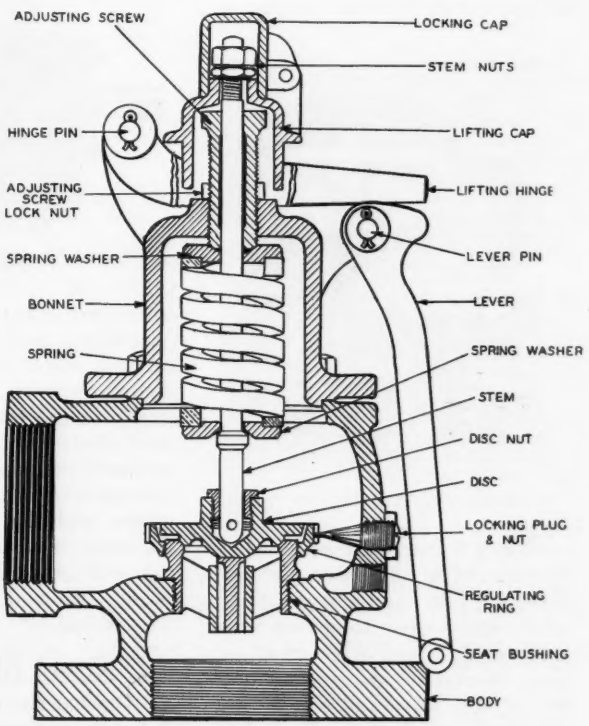
Safety Valves

WHAT IS blowdown or blowback in a safety valve? How is it regulated? How is the pressure at which the valve pops adjusted? A. L. E.

A. Blowdown or blowback of a safety valve is the pressure drop necessary to close a safety valve after it pops. For instance, if a valve pops at 205 lb. pressure and does not close until the pressure drops to 198 lb., the blowdown is 205 minus 198 or 7 lb. All safety valves are constructed with a regulating ring so that this blowdown can be regulated. The cross-section of one particular safety valve with the different parts named is shown in the accompanying illustration.

Manufacturers' direction for the blowdown adjustment is as follows: To adjust the blowdown of the valve, screw the locking pin outward from the body until inside ring is free to turn. To decrease blowdown, turn regulating ring down. To increase blowdown, turn regulating ring up. When the valve has the desired blowdown (3 to 8 lb., depending on the pressure), replace locking pin and lock by means of the locknut. The end of the locking plug should be placed in one of the notches on the regulating ring, but should not be permitted to bear on the regulating ring. There should be a slight amount of play in the regulating ring after the locknut has been tightened.

A. S. M. E. Boiler Code regulations regarding blowdown are as follows: Safety valves shall operate without clattering and shall be set and adjusted as follows: To



PARTS OF A SAFETY VALVE

close after blowing down not more than 4 per cent of the set pressure but not less than 2 lb. in any case. For spring-loaded pop safety valves operating on pressures up to and including 300 lb. per sq. in., the blowdown shall not be less than 2 per cent of the set pressure. To insure the guaranteed capacity and satisfactory operation, the blowdown as marked upon the valve shall not be reduced.

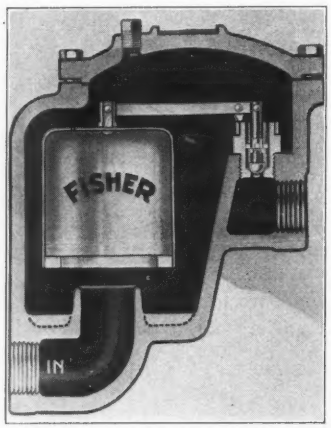
Regulation of the pressure at which the illustrated valve will pop is given by the manufacturer in the following paragraph: To reset the valve, open the lock or seal, remove the caps, throw back the lifting hinge and loosen the adjusting screw locknut. To decrease popping pressure, turn the adjusting screw up. To increase popping pressure, turn the adjusting screw down. After the desired popping point has been attained, screw the hexagon nuts on the stem until they rest on cap, back up nuts one-half turn, and secure. Special care should be taken not to have the nuts ride on the cap.

New Equipment

Inverted Bucket Trap

AFTER OVER 2 yr. development, the Class ST trap is offered by Fisher Governor Co., Marshalltown, Iowa.

By removal of the cover all parts become accessible for inspection or renewal without breaking pipe connections, which, as shown, are horizontal but in different planes.



FISHER INVERTED BUCKET TRAP

Novel features are provision for adjustment of the valve post when renewing parts and positive guiding of the inner valve to ensure correct seating. Body and cover are of semi-steel; bucket of heavy spun brass; lever, pins, valve and seat of stainless steel, the last two heat-treated to resist temperature, wire-drawing and corrosion.

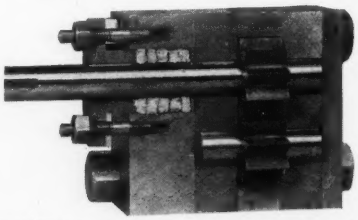
Nitralloy Steel Pumps

NEW AND LARGER series of nitralloy steel pumps to be known as the "XE" series are announced by the Northern Pump Co., Minneapolis, Minn.

Using the same laminated plate construction as in the two smaller series XA and XD, the company now has nitralloy pumps to offer in capacities from ¼ to 42 g.p.m. at 1200 r.p.m. The new series XE capacity range is from 14 g.p.m. to 42 g.p.m. at 12 r.p.m.

Extreme hardness of nitralloy steel (1000 Brinell) makes these pumps ideal for all types of oil services, including the handling of dirty crude oils and distillates at high pressure. For non-lubricating oils, the XE pumps would be equipped with nitralloy plate bearings such as shown in the accompanying section. Roller bearing pumps handling clean lubricating oil would be good for pressures up to 1600 lb. on continuous service.

Because of the high efficiency

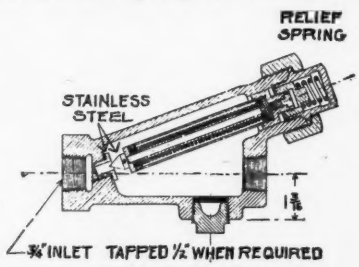


SECTION OF NORTHERN PUMP CO. XE PUMP

and wear resisting qualities, these nitralloy pumps with roller bearings will be suited for installations on hydraulic hoists, dump trucks, stokers, machine tools, road machinery and hundreds of other hydraulically operated mechanisms. The same XE pumps built with nitralloy bearing plates will find a market for fuel oil burners in industrial plants and for all types of transfer service where non-oxidizing liquids are to be handled.

Novel Steam Trap

DEVELOPED FOR draining foot warmers on locomotives, the Sarco trap No. 8 is provided with outside pressure adjustment, locking device to hold the adjustment from alteration, relief spring for the built-in



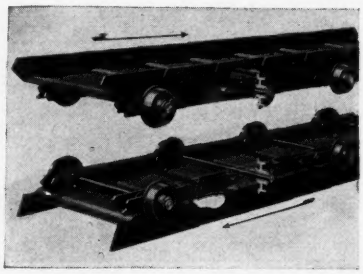
SARCO TRAP NO. 8

cartridge and openings for straightway or angle connection. It is made by Sarco Co., Inc., 183 Madison Ave., New York, N. Y., and obviously is applicable for many industrial plant purposes.

Gravity Seal Apron Conveyor

FOR LONG-TIME operation under exceptionally severe operating conditions, the Gravity Seal steel apron conveyor has been perfected by the Webster and Weller Mfg. Cos., Chicago. By a new method of attaching the conveyor pans to the chains by means of a patented pivot link, the pans overlap snugly so as to eliminate leakage of material yet provide such flexibility that the conveyor travels evenly, without strain around the sprockets.

Cross rods, mounted through the center of the chain links are fitted with extra length bushings, all roller parts being replaced without interfering with the operation of the conveyor. Each pair of rollers carries



NEW TYPE APRON CONVEYOR

the load of two full pan pitches on both carrying and return runs of the conveyor, rollers being idle only while the apron passes over sprockets.

Instant Ice Water Cooler

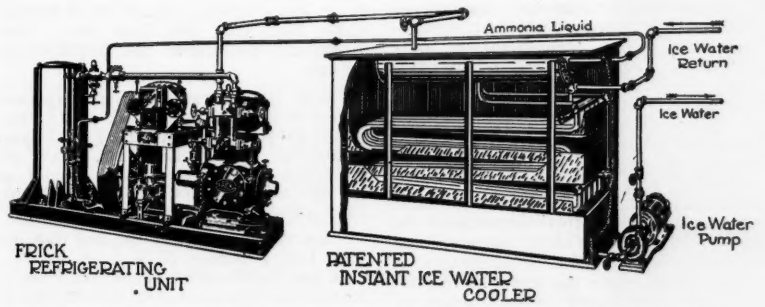
EQUIPMENT for use in milk cooling has been developed by the Frick Co., Waynesboro, Pa. This same type of water cooler can also be used in supplying ice water in plants for making carbonated beverages, as well as in bakeries, or for cold drinking water systems, precooling of water in ice making plants and air conditioning and similar work. These zigzag coils have been used for cooling brine in cold storage plants of various sizes.

The instant ice water cooler is compact, measuring only 10 ft. 8 in. long by 3 ft. wide and stands 7 ft.

high, over-all, and yet is large enough to handle 60 t. of refrigeration. When furnished in an intermediate size and operated at 35 lb. suction pressure it will produce 36 deg. ice water at the rate of 36,000 lb. per hr. equivalent to a flow of about 75 g.p.m.

When this unit is used, with a 21,000-lb. per hr. milk cooler, it will cool the milk through a range of about 30 deg. or from say, 70 to 40 deg.

A small size instant ice water cooler is available with a capacity of about 15 t. refrigeration, large enough to handle a 6000-lb. per hr. milk cooler through a range of say 30 deg. This cooler measures only 2 ft. 1 in. wide and will give over 20 t. capacity with ammonia at a colder temperature. Three larger coolers are available, providing capacities to suit any requirements.



FRICK CO. COOLING UNIT AS ARRANGED FOR COOLING MILK

IN A NEW TYPE of pump for handling sewage and storm water or for general drainage or condenser circulating service, announced by Morris Machine Works, a feature of special interest is the propeller, of screw type with vanes somewhat similar to those of a ship's propeller. This has two important characteristics; widely spaced open vanes permit passing solids of large size without danger of clogging and the design permits delivering large quantities of water at low heads when operating at comparatively high rotative speeds, so that for such service the pump is well suited for direct motor drive. On plant test a 42-in. pump is stated to have shown an efficiency of more than 85 per cent when delivering 45,000 g.p.m. against a total head of 22½ ft., operating at 600 r.p.m.

Smaller Industries Conference

AT SILVER BAY, N. Y., on Lake George, a conference for executives of smaller industries will be held, July 11 to 16, by the Silver Bay Industrial Institute of which Arthur H. Young is chairman.

Information gathered by the committee sponsoring the conference indicates that the "little fellow" in industry is in position to give pointers to his big brother, since most of the outstanding successes in 1931 were by smaller plants. Importance of small industries is evident because in all the United States approximately only 3 per cent of the industrial organizations employ more than 250 workers and only 1.4 per cent more than 500 workers, while plants having 500 or less employ 62 per cent of industrial wage earners. Evidently recovery in industry depends quite as much on improvement in condition of the small organizations as on recovery of our industrial giants.

Spite of this, it is felt by managers of smaller industries that in general industrial conferences their problems are given insufficient consideration, hence the plans for the small industries meetings.

Some of the topics to be considered are: The Job Ahead to Increase Management Effectiveness; Relation of Size of Unit to Success; Good Management of Finance, Sales, Production and Personnel for the Small Company; Production Standards and Payment Schemes; Advertising; Industrial Stabilization; Cooperation of Small Industries and Their Place in Trade Organizations.

The conference will have an important bearing on social as well as industrial problems, since present conditions prove that, however well some large organizations provide for the hazards of employment, general solution of the problem must depend on acceptance by smaller establishments of like responsibility. Some have already done so and will bring their experience for the benefit of others.

James W. Towsen is chairman of the organization committee, with offices at 51 E. 42nd St., New York, N. Y.

News From the Field

SALES BRANCH has been established in Grand Rapids, Michigan, by the Reliance Electric & Engineering Co., Cleveland, Ohio, in charge of Marshall T. Ball.

SULLIVAN MACHINERY CO. has removed its Knoxville, Tenn., office to 803 Medical Arts Bldg., with E. L. Thomas as manager.

PITTSBURGH EQUITABLE METER CO., Pittsburgh, Pa., and Merco Nordstrom Valve Co., San Francisco, Cal., announce the consolidation of the two organizations. The Pittsburgh company is to acquire all the capital stock of Merco Nordstrom, which will operate as a division of Pittsburgh Equitable Meter Co., with W. F. Rockwell as president.

ALCO PRODUCTS, Inc., New York, has opened a new branch office in the Rialto Building, San Francisco, Cal. This office is under the charge of R. S. Danforth whose territory includes all of California.

AT THE FIFTH Midwest Bituminous Coal Conference held at Purdue University, attendance of 320 included dealers, buyers, stoker manufacturers and engineers. Subjects considered were the competition of coal with natural gas, modernization of plants to use Midwest coal with returns of 15 to 35 per cent a year on investment, determination of useful value of coal, modification of stoker design to handle coals with ash fusion temperature under 2300 deg. F. Better service to domestic users and trouble shooting in small plants were also discussed at one session.

NAME of the Fuel Oil Testing Plant, Navy Yard, Philadelphia, Pa., has been changed to U. S. Naval Boiler Laboratory, according to an announcement by Lybrand Smith, Commander, U. S. N., officer in charge.

JAMES S. WATSON, formerly vice president in charge of Link-Belt Co.'s Dodge Works, Indianapolis, has been appointed vice-president and general manager of both the Dodge and the Ewart Works, chain factories, succeeding George P. Torrence, who was recently elevated to the presidency. Frank S. O'Neil has been appointed assistant general manager of both Indianapolis plants and C. Walter Spalding has been appointed sales manager of Ewart plant products.

E. W. WAGENSEIL, who has, for the past five years, been in charge of air preheater sales for Blaw-Knox Co., is now in the Pittsburgh Sales Engineering Department of Hagan Corp. For 18 yr. before coming to Blaw-Knox Co., Mr. Wagenseil was engaged in stoker engineering and sales, having been Westinghouse representative at Chicago and later sales manager of the Harrington Stoker. His work during the past 5 yr. with Blaw-Knox Co. was principally concerned with the application of preheated air to heating furnaces, soaking pits, etc., in the steel industry.

For the Engineer's Library

COMPETITIVE POSITION OF COAL in the United States, 288 pp., charts and tables, 6 by 9 in., cloth. National Industrial Conference Board, New York, 1931; price, $3. Mining of coal, our most important mineral product and the basis of our industrial structure, has been characterized as a "sick industry." For several years, coal output has lagged behind increase in industrial activity and in this book analysis is attempted of that situation by a study of past and present conditions, activities from which demand for coal arises, factors which limit demand for coal and the competitors of coal for supply of energy and power.

In the analysis are considered the trend of world coal trade, market in the United States and the competition with oil, gas and water power, major uses of coal for power and light, manufacturing, transportation and heating. The market is studied by regions as to production, distribution and consumption considering both bituminous and anthracite fuels.

In conclusion, comparison is made of governmental control and control by the industry itself. Evolution toward fewer and larger companies is suggested as a solution, realizing that this means extinction of smaller and less efficient organizations, but this is a process that has been under way since 1920. The end sought is stabilization of the industry, avoidance of demoralizing price cutting during periods of excess supply, unwarranted expansion during coal shortages, regular employment for miners and prevention of wide price fluctuations.

It is interesting that for 1929, the latest figures available, the percentages of energy supplied were as follows: Bituminous coal, 56.1 per cent; fuel oils, 12.3 per cent; motor fuel, 11.3 per cent; natural gas, 7.8 per cent; anthracite, 7.7 per cent; water power, 3.6 per cent; kerosene, 1.1 per cent; petroleum coke, 0.1 per cent. This is for all forms of energy, heat, light and power, for all users.

Many interesting facts are shown by the tables and charts and its study will be of assistance in clarifying coal industry problems as well as in guiding in purchase of coal for a given location.

JOBS FOR THE COLLEGE GRADUATE IN SCIENCE, by Edward J. K. Menge, 5½ by 8 in., 175 pages. The Bruce Publishing Co., Milwaukee, Wis., 1932; price, $2.00.

To the high school or college student with a liking for sciences and faced with the problem of making a selection of some branch as a specialty, Dr. Menge, Director of the Department of Zoology, Marquette University, gives many helpful facts relative to the number engaged, the income, qualification and training, employing institutions, class of work and professional organizations in each of the branches of modern science. The chapter headings are: The Mathematicians, the Physical and Chemical Group; The Medical Group; Engineering; The Biological Sciences; and appendices on botany and privately endowed research institutions. In his introduction the author expresses some sound views on the education of students in science and calls attention to the three ways of earning a livelihood in each scientific specialty, i.e., as practitioner, educator or research scientist.

BEHEMOTH, THE STORY OF POWER, by Eric Hodgins and F. Alexander Magown; 350 p., illustrated, 6 by 9 in., 1932, cloth, $3.50. Doubleday, Doran & Co., Inc., Garden City, N. Y.

Whimsical, humorous, interesting yet historically accurate, the authors have traced the beginnings and development of steam, electrical internal combustion and hydraulic power, with their applications to lighting, manufacturing, railroading, marine propulsion and automobiles. While nothing before unknown to engineers is disclosed, the growth from the first crude attempts to substitute machines for muscular effort is traced, also the early glimpses of scientific truth and possibility and the long slow development of these principles into workable constructions. In this discussion, the part which each thinker, inventor and improver had in the developments is shown, clearing up the many controversies that have raged as to priority of ideas and construction in steam engines, locomotives, steamboats and electrical machinery. Reading this book is worth while to refresh one's memory as to the work of pioneers in science and engineering as well as for enjoyment of the authors' humorous and unique characterization of the actors and the events in the drama of the growth of power to its present dominance in human affairs. It is delightfully enjoyable as well as profitable, a combination seldom found in books pertaining to engineering subjects.

COMBUSTION ENGINEERING CORP., 200 Madison Ave., New York, is distributing copies of an 8-page bulletin describing the new steam generating unit recently placed in operation at the Duluth Station of the Minnesota Power & Light Co. This unit comprises one of the largest single-pass, sectional-header boilers ever installed, together with an all-water-cooled furnace equipped for the horizontal firing of pulverized fuel. The installation is notable not only because of its size and design but because it is the only source of steam supply for a 20,000-kw. turbine-generator, thus conforming to the trend in plant design which recognizes the modern steam generating unit as having an availability factor comparable with that of generating equipment.

Installation and design of sectional header boilers, bent tube boilers, low-head room boilers and horizontal fire tube boilers are covered in a new catalog, Bulletin B-32-3, just issued by the Foster Wheeler Corp., 165 Broadway, New York, N. Y.

HEAT EXCHANGERS, their construction details, types and applications are discussed in Bulletin HE-2, just issued by Henry Vogt Machine Co., Louisville, Ky. These are of shell and tube type for all temperatures, pressures and vacuums, also in multitube pipe style as used in oil refinery work.

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY announces two 8-page, illustrated circulars on its new line of "De-ion" circuit breakers. These breakers use a new method of arc extinction that enables elimination of all fuses in panelboards, distribution switchboards within the breaker's capacity and industrial application where fused safety switches are now used. Circular 1939 contains a general description of the new breakers, breaker ratings and their applications. Circular 1937 gives construction and application details of the 225-amp. breaker.

CHARACTERISTICS of Tru-Lay preformed wire rope are illustrated and described in a 16-p. booklet issued by American Cable Co., Inc., 230 Park Ave., New York, N. Y. Copies are available on request.

HOW SIX REPRESENTATIVE CONCERNS CUT POWER COSTS is the title of an illustrated bulletin just issued by Troy Engine & Machine Works, Troy, Pa., giving descriptions of equipment and amount of savings made by six typical plants that have installed this company's engines.

ELECTRIC SERVICE for Oil and Gasoline Pipe Line Pumping, N. E. L. A. Publication No. 25, 70 cents to members, 95 cents to non-members, has just been issued as a report of the General Power Committee, National Electric Light Association, 420 Lexington Ave., New York. It gives a brief history of the application of electric power to oil and gasoline pipe line pumping. Maps, illustrations and data are included, also description of individual systems showing growth and extent of use of electric power in this field. A bibliography concludes the report.

J. E. RHOADS & SONS has just issued a new folder describing its new product—Tannate Special Rounded Belt.

POWER STATION BETTERMENT, Publication 211; 20 cents to members, 30 cents to non-members, has just been issued as a report of the Prime Movers Committee, N. E. L. A., 420 Lexington Ave., New York. In this report the term Power Station Betterment is exactly defined and numerous methods are listed for attaining the objectives outlined, through improved operating and maintenance practices and improvements in physical equipment. Tests are included to determine the feasibility of proposed changes in practices or equipment. The case of a station is cited in which the capacity was increased 18,000 kw. and the heat rate reduced 9 kb. per kw-hr. by the installation of one high-pressure boiler and turbine.

APPARATUS for Electrical Resistance Measurements are discussed in a recent 32-page illustrated bulletin No. 40, containing details of equipment and operating principles, just published by Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.

INVINCIBLE VACUUM CLEANERS for power plant and industrial plant applications are described in a new bulletin issued by Invincible Vacuum Cleaner Mfg. Co., Dover, Ohio.

FISHER Inverted-Bucket Type steam trap is shown in detail and dimensions and capacities given for sizes from ⅜ to 1¼-in. pipe connection in a bulletin recently issued by Fisher Governor Co., Marshalltown, Iowa.

PORTABLE and Stationary Vacuum Cleaners are described and illustrated in Bulletin No. 387 just published by B. F. Sturtevant Co., Hyde Park, Boston, Mass.